FURUNO

OPERATOR'S MANUAL

MARINE RADAR

MODEL FR-7041R

FURUNO ELECTRIC CO., LTD.
NISHINOMIYA, JAPAN

9-52, Ashihara-cho,
Nishinomiya, Japan 662

Telephone: 0798-65-2111
Telefax: 0798-65-4200

・Your Local Agent/Dealer

FIRST EDITION : JUL 1994
F : MAR. 4, 1998

(TATA) PUB. No. OME-33940
FR-7041R

00080613500

⚠ SAFETY INSTRUCTIONS

"**DANGER**", "**WARNING**" and "**CAUTION**" notices appear throughout this manual. It is the responsibility of the operator and installer of the equipment to read, understand and follow these notices. If you have any questions regarding these safety instructions, please contact a FURUNO agent or dealer.

⚠ DANGER	This notice indicates a potentially hazardous situation which, if not avoided, will result in death or serious injury.
⚠ WARNING	This notice indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠ CAUTION	This notice indicates apotentially hazardous situation which, if not avoided, could result in minor or moderate injury, or property damage.

⚠ WARNING



Hazardous voltage.
Can shock, burn, or cause death.

Only qualified personnel should work in the unit.

Turn off the power at the ship's mains switchboard before beginning the installation. Post a warning sign near the switchboard to ensure the power will not be applied while the radar system is being installed.

Electrical shock, fire, serious injury or death can result if the power is not turned off, or is applied while the equipment is being installed.

⚠ CAUTION



Ground both the display unit and the antenna unit.

Ungrounded equipment can give off or receive interference or cause electrical shock.

Confirm that the power supply voltage is compatible with the voltage rating of the equipment.

Connection to the wrong power supply can cause fire or equipment damage. The voltage rating appears on the label at the rear of the display unit.

Use only the supplied power cable.

Use of other power cables (particularly a cables whose diameter is smaller than the supplied cable) can cause fire or short circuit.

Use the correct fuse.

Use of a wrong fuse can cause fire or equipment damage.

NOTICE

The installation must be done by a FURUNO representative or suitably qualified radar technician.

Authorities require this.

The mounting location must satisfy the following conditions:

- Useable temperature: -15°C to 55°C
- Out of direct sunlight
- Away from air conditioner vents
- Well ventilated

Observe the compass safe distances to prevent deviation of a magnetic compass.

	Standard compass	Steering compass
Display Unit	1.0m	0.8 m
Scanner Unit	0.7 m	0.5 m

Keep magnets and magnetic fields away from the equipment.

Magnetic fields will distort the picture and can cause equipment malfunction. Be sure the unit is well away from equipment which gives off magnetic fields (speaker, power transformer, etc.).

Locating a Ship or Survival Craft in Distress by SART

SART background

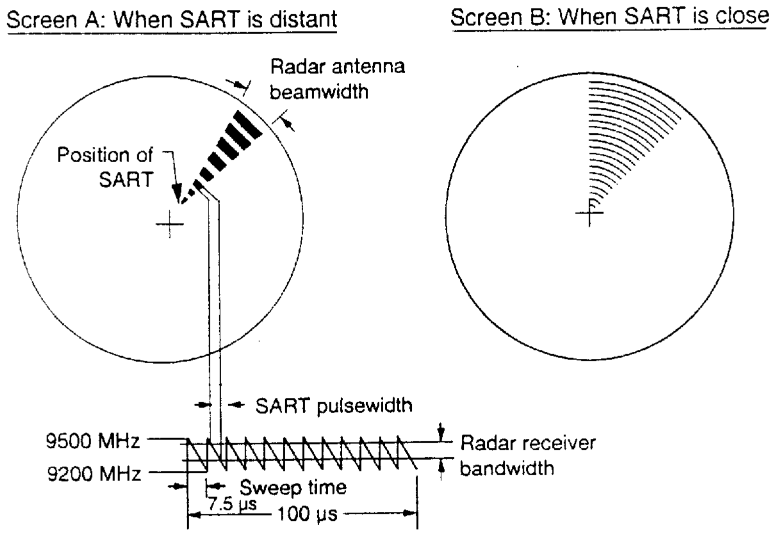
The SART is required on vessels of 300 GT and above by the 1974 SOLAS Convention as amended in 1988 (GMDSS). Performance standard is specified in IMO Resolution A.697 (17).

SART activating conditions

The SART should operate correctly when interrogated at a distance of up to at least five miles by a navigational radar complying with resolutions A.477(XII) and A.422(VII) and IEC 936, with an antenna height of 15 meters. (It should also operate correctly when interrogated at a distance of up to 30 miles by an airborne radar with at least 10 kW peak output power at a height of 3,000 feet.)

How SART works

Upon receiving a radar signal from a rescue party, the SART automatically transmits a series of twelve frequency sweeps at a frequency between 9200 (+0/-60 MHz) and 9500 MHz (-0/+60 MHz). The radar will represent twelve SART marks during one sweep cycle on the screen. See the figure below.



The length of a SART mark depends on the radar's receiver bandwidth and sensitivity. For the bandwidth of 12 MHz, the length is 45 meters approximately and for the bandwidth of 3 MHz (usually on the 6 mile range or larger), 12 meters approximately.

To show the SART marks only on the radar display, detune the radar receiver by turning the TUNE control out of best tuning condition. This erases or weakens all normal radar echoes; but, the SART marks are not erased because the SART response signal scans over all frequencies in the 9 GHz band. When the radar approaches the SART in operation, the SART marks will enlarge to large arcs, blurring a large part of the screen. Reduce the sensitivity and adjust the sea clutter control of the radar.

Table of Contents

Foreword iii

Specifications v

1. Operational Overview

Control Panel 1-2
Turning the Radar On and Off 1-3
Transmitting, Stand-by 1-4
Economy Mode 1-4
Navigation Data Display During Stand-by 1-4
Selecting a Range 1-5
Adjusting Receiver Sensitivity 1-6
Suppressing Sea Returns 1-6
Adjusting Display Brilliance 1-7
Erasing the Heading Mark 1-8
About Tuning 1-8
The Menu 1-9
Measuring Range 1-12
Measuring Bearing 1-13
Collision Assessment by the Offset EBL 1-15
Measuring Range and Bearing Between Two Targets 1-16
Suppressing Precipitation Returns 1-17
Suppressing Radar Interference 1-18
Enlarging an Area of Interest 1-19
Shifting the Picture 1-20
Guard Alarm 1-21
Trailing Target Movement 1-24
Displaying Navigation Data 1-26
Outputting Cursor Position to External Equipment 1-27
Magnifying Long Range Echoes 1-27
Watchman 1-27
Displaying Index Lines 1-28
Remote Controller 1-29
Displaying Cursor Range and Bearing, Cursor Position 1-29
Display Indications 1-30

2. Performance and Interpretation

The Radar Wave and Radar Horizon 2-1
Target Properties and Radar Wave Reflection 2-2
Range Resolution 2-3
Bearing Resolution 2-4
False Echoes 2-4

3. Maintenance

Maintenance Program 3-2
Replacing the Fuse 3-3
Location of Parts 3-3

4. Troubleshooting

Precautions 4-1
Troubleshooting Table 4-2
Transmitting With Scanner Rotation Suspended 4-3

5. Installation

Installation Precautions 5-1
Scanner Unit Installation 5-2
Display Unit Installation 5-8
Connections 5-10
Checking the Installation 5-12
Adjustments on the Installation Setup 1 Menu 5-12
Aligning Heading 5-14
Adjusting Sweep Timing 5-15
Measuring Blind and Shadow Sectors 5-16
Preventing Transmission in an Area 5-18
Adjusting Magnetron Heater Voltage 5-19

List of Outline Drawings & Schematic Diagrams D-0

Foreword

FURUNO Electric Company thanks you for purchasing the FR-7041R Marine Radar. We are confident you will discover why the FURUNO name has become synonymous with quality and reliability.

For over 40 years FURUNO Electric Company has enjoyed an enviable reputation for quality and reliability throughout the world. This dedication to excellence is furthered by our extensive global network of agents and dealers.

Your radar is designed and constructed to meet the rigorous demands of the marine environment. However, no machine can perform its intended function unless properly installed and maintained. Please carefully read and follow the operation and maintenance procedures set forth in this manual.

We would appreciate feedback from you, the end-user, about whether we are achieving our purposes.

Thank you for considering and purchasing FURUNO.

Features

The FR-7041R has a large variety of functions, all contained in a rugged plastic case.

All controls respond immediately to the operator's command and each time a key is pressed, the corresponding change can be seen on the screen.

- Daylight viewing radar specially designed for small craft and sailing yachts.
- Traditional FURUNO reliability and quality in a compact radar.
- High definition 12-inch (30 centimeter) raster-scan display.
- Precision 1.2 meter slotted waveguide antenna capable of withstanding 70 knot wind velocity.
- Eight levels of target quantization for high target definition.
- On-screen alphanumeric readout of all operational information.
- Guard zone alarm watches for targets entering (or exiting) a guard zone.
- Operates on 12V, 24V or 32V DC power supply and consumes only 52 watts.
- The CRT can be turned off automatically during stand-by to reduce power consumption.
- Ship's position in latitude and longitude, ship's speed, and range and bearing to a waypoint can be shown in the bottom text area with navigation input in NMEA 0183 format.
- Remote control unit provides armchair control of range, transmission and screen off centering.
- Target latitude and longitude position can be output to external equipment.
- Transmission can be prevented in a certain area. Ask you serviceman about this feature.

SCANNER UNIT

Radiator	Slotted waveguide array
Polarization	Horizontal
Antenna Rotation Speed	48 rpm nominal
Radiator Length	120 cm
Horizontal Beamwidth	Less than 1.9°
Vertical Beamwidth	22°
Sidelobe Attenuation	Within ±20° of mainlobe: less than -24 dB Outside ±20° of mainlobe: less than -30 dB
Wind Speed Resistance	Relative wind speed 51.5 m/s (100 knots)

TRANSCEIVER MODULE

Frequency	9410 MHz ±30 MHz (X band)
Modulation	P0N
Peak Output Power	4 kW
Transmitting Tube	Magnetron MG5248
Warmup Time	2 minutes 30 seconds

Pulselength (PL) & Pulse Repetition Rate (PRR)

<table>
<tr><th colspan="2"></th><th colspan="15">Range (kilometers)</th></tr>
<tr><th>PL</th><th>PRR</th><th>0.125</th><th>0.25</th><th>0.5</th><th>0.75</th><th>1</th><th>1.5</th><th>2</th><th>3</th><th>4</th><th>6</th><th>8</th><th>12</th><th>16</th><th>24</th><th>32</th></tr>
<tr><td>SP</td><td>2100 Hz</td><td colspan="8">0.06 us</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>MP</td><td>1700 Hz</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="3">0.3 us</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>LP</td><td>1000 Hz</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="6">0.8 us</td></tr>
</table>

Spurious Rejection	Better than -40 dB
Modulator	FET switching method
Intermediate Frequency	60 MHz
Tuning	Automatic or manual (for manual, select manual tuning on menu and tune by trackball)
Receiver Front End	MIC (Microwave IC)

Bandwidth 7 MHz

Duplexer Circulator with diode limiter

DISPLAY UNIT

Indication System PPI daylight display, raster scan

Picture Tube 12-inch rectangular (184 mm x 245 mm) monochrome CRT, effective display area more than 180 mm

Range (km), Ring Interval (km), No. of Rings

Range	0.125	0.25	0.5	0.75	1	1.5	2	3	4	6	8	12	16	24	32
Ring Interval	0.0625	0.125	0.125	0.25	0.25	0.5	0.5	1	1	2	2	3	4	6	8
Rings	2	2	4	3	4	3	4	3	4	3	4	4	4	4	4

Range Resolution Better than 15 m

Bearing Resolution Within 1.9°

Minimum Range Better than 25 m

Bearing Accuracy Within 1°

Range Ring Accuracy 0.9% of range or 8 m, whichever is the greater

VRM Accuracy 0.9% of range or 8 m, whichever is the greater

Markers Heading Mark, Bearing Scale, Range Rings, Variable Range Marker (VRM1, VRM2), Electronic Bearing Line (EBL1, EBL2), Tuning Bar, Cursor, Index Lines, Alarm Zone, Way-point Mark (navigation input required), North Mark (heading sensor input required)

Alphanumeric Indications Range, Range Ring Interval, Pulselength (SP, MP, LP), Interference Rejection (IR1, IR2, IR3), Variable Range Marker (VRM1, VRM2), Electronic Bearing Line (EBL1, EBL2), Stand-by (ST-BY), Radar Alarm (G (IN), G (OUT), G (ACKN)), Echo Stretch (ES1, ES2), Cursor Range, Bearing or L/L Position, Echo Trailing (TRAIL), Trailing Time, Trailing Elapsed Time, Navigation Data (navigation input required), Heading (HDG; heading sensor input required)

Interference Rejector Built-in

Output Data TLL (target data) and RSD, NMEA 0183 format

ENVIRONMENTAL CONDITIONS

Ambient Temperature Scanner unit: -25°C to +70°C
Display unit: -15°C to +55°C

Humidity Relative humidity, 95% or less at +40°C

POWER SUPPLY

10.2 to 41.6 VDC, 85W, or100V, 110V, 115V, 220V, 230V AC, 50/60 Hz, 1ø (rectifier required)

COLOR

Unit	Color	
Scanner	Upper	N9.5
Display	Chassis	2.5GY5/1/5
	Panel	N3.0

COMPASS SAFE DISTANCE

Unit	Standard Compass	Steering Compass
Display	1.0 m	0.8 m
Scanner	1.0 m	0.74 m

EQUIPMENT LISTS

Complete set

Name	Type	Code No.	Qty	Remarks
Scanner Unit	XN12A-RSB-0065	000-085-687	1	
Display Unit	RDP-110		1	
Remote Controller	RCU-009-E	000-085-691	1	
Installation Materials	CP03-13001		1 set	See installation materials on next page for details.
Accessories	FP03-05300	000-085-767	1 set	
Spare Parts	SP03-10200	000-085-692	1 set	

Accessories

Name	Type	Code No.	Qty	Remarks
Hood Assy.	FP03-02910	008-223-520	1	
Cap	FP03-04310	008-411-810	1	
Filter	FP03-02920	008-224-760	1	

Installation materials

Name	Type	Code No.	Qty	Remarks
Signal Cable Assy. Signal Cable Assy. Signal Cable Assy. Signal Cable Assy. Signal Cable Assy.	S03-48-5 S03-48-10 S03-48-15 S03-48-20 S03-48-30	008-450-910 008-441-340 008-441-350 008-441-360 008-441-370	5 m 10 m 15 m 20 m 30 m	Select one. Connector fitted at both ends.
Power Cable Assy.	03S9235	000-134-086	1	5 m
Seal Washer	CW1053DX	000-850-021	4	Type CP03-13001, for scanner unit
Hex Bolt	M12 x 60 SUS 304	000-862-191	4	
Hex Nut	M12 SUS 304	000-863-112	4	
Flat Washer	M12 SUS 304	000-864-132	4	
Spring Washer	M12 SUS 304	000-864-263	4	
Slotted Pin G-type	ø10 x 45 SUS	000-866-390	2	
EMI Core	ESD-SR-25	000-123-303	1	

Spare parts

Name	Type	Code No.	Qty	Remarks
Fuse	FGBO 15A 125VAC	000-549-014	2	For 12V power
Fuse	FGBO 10A 125VAC	000-549-065	2	For 24V/32V power

Optional equipment

Name	Type	Code No.	Qty	Remarks
Rectifier	RU-3423	000-030-443	1	For AC power
External Buzzer	OP03-21-3	000-030-097	1	
NMEA Cable Assembly	MJ-A6SPF0011-050	000-132-244	5 m	6 pin-4 pin, cross
	MJ-A6SPF0011-100	000-132-336	10 m	
	MJ-A6SPF0012-050	000-134-424	5 m	6 pin-6 pin, cross
	MJ-A6SPF0012-100	000-133-817	10 m	
EMI Filter	FP03-05500	008-456-990	1	
Dust Cover	03-038-9001	000-801-826	1	
Hood w/Lens	OP03-120	008-441-880	1	

1. Operational Overview

Overview

This radar is basically very easy to operate. If you change a control setting you will see the associated reaction almost immediately on the screen. Most keys carry abbreviated names to show their functions. The same nomenclature appears on the display for your confirmation.

To familiarize yourself with the controls of your radar, turn it on (presuming it is installed) and try operating some of the controls as you review this section.

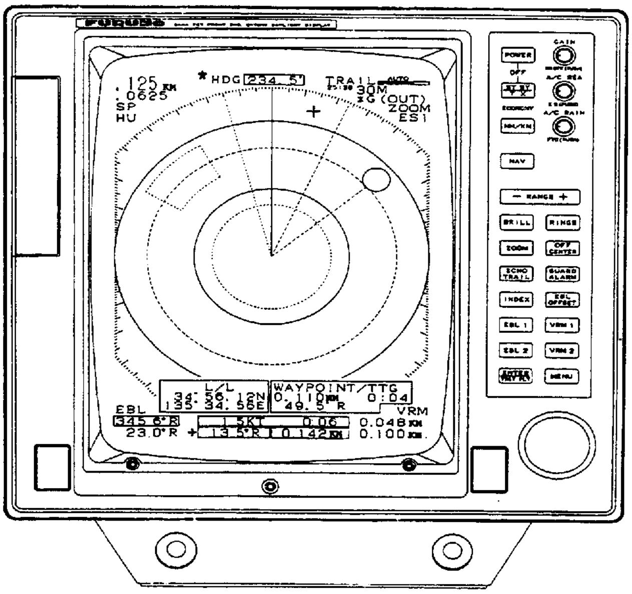
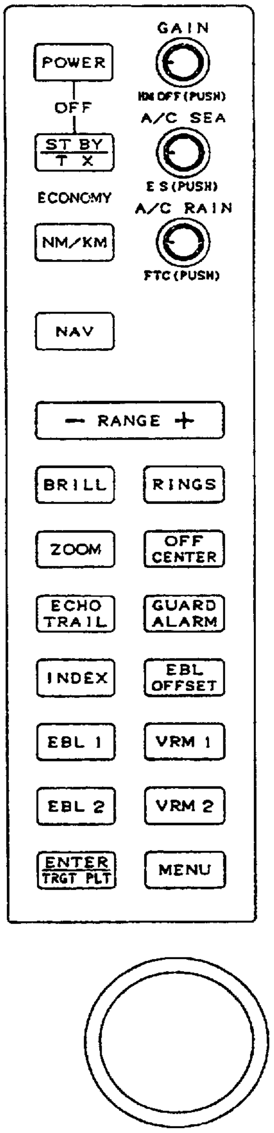


Figure 1-1 Display unit

** Heading display requires heading input. Nothing appears when there is no heading input.*

Control Panel



POWER

Turns power on.
Press together with **STBY TX** to turn power off.

STBY TX

Alternates between stand-by and transmit.

ECONOMY

Lights when economy mode is on.

NM/KM

Selects unit of range measurement for nm or km.

NAV

Turns navigation data on/off.

RANGE

Selects range.

BRILL

Adjusts display brilliance.

ZOOM

Doubles size of area between your vessel and cursor location.

ECHO TRAIL

Displays target movement in afterglow.

INDEX

Turns index lines on/off.

EBL1, EBL2

Turns corresponding EBL on/off.

ENTER, TRGT PLT

Registers settings on menu; displays cursor L/L position and cursor range/bearing alternately; outputs cursor position to external equipment.

GAIN, HM OFF

Control: Adjusts sensitivity of radar receiver.
Switch: Temporarily erases heading mark.

A/C SEA, ES

Control: Reduces sea clutter.
Switch: Enlarges echoes.

A/C RAIN, FTC

Control: Reduces rain clutter.
Switch: Reduces heavy precipitation clutter.

RINGS

Turns range rings on/off and adjusts their brilliance.

OFF CENTER

Shifts vessel's position to cursor location.

GUARD ALARM

Sets/cancels guard alarm; silences aural alarm.

EBL OFFSET

Measures range and bearing between two targets; assesses risk of collision.

VRM1, VRM2

Turns corresponding VRM on/off.

MENU

Opens/closes the menu.

Trackball

- Shifts cursor, EBL and VRM.
- Sets guard zone.
- Selects menus, options.
- Shifts origin of EBL and VRM.

Turning the Radar On and Off

CAUTION: *The radar scanner emits high frequency radio radiation which can be harmful, particularly to your eyes. Never look directly into the scanner from a distance of less than two feet when the radar is in operation as you could injure the cornea of your eyes. Always make sure no person is near the scanner unit before turning on the radar.*

Turning on the radar

Press the **POWER** key. The control panel lights and a timer displays the time remaining for warm up of the magnetron, counting down from 2:29 to 0:01. Further, the bearing scale, range, range ring interval, pulselength, and presentation mode are displayed. (The figure below does not show those indications and markers.)

Function at stand-by can be selected through the menu.

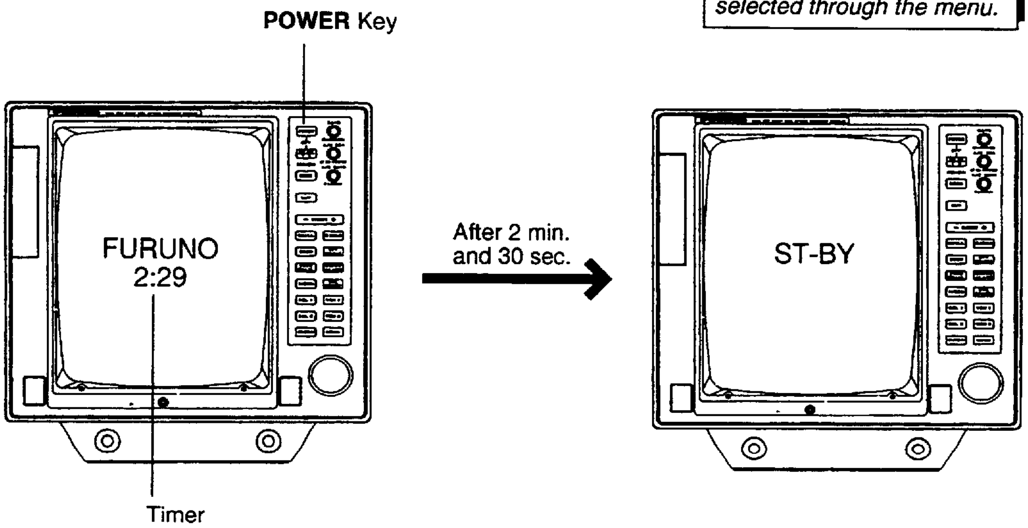


Figure 1-2 Display unit, showing warmup sequence

Turning off the radar

Press **POWER** and **STBY TX** keys together.

Transmitting, Stand-by

Transmitting

After the power is turned on and the magnetron has warmed up, "ST-BY" (Stand-By) appears at the screen center. In stand-by the radar is available for use at anytime—but no radar waves are being transmitted.

Press the **STBY TX** key to transmit. When the radar is transmitting, any echoes from targets appear on the display. This radar displays echoes in eight intensity levels according to echo strength.

Each time the radar is powered it begins operation with last used settings for echo stretch, menu, display mode, tuning method (automatic or manual), range, display brilliance, echo trail, picture off center, EBL, VRM, A/C SEA, and guard alarm.

Stand-by

When you won't be using the radar for an extended period, but you want to keep it in a state of readiness, place it in stand-by by pressing the **STBY TX** key. The display shows "ST-BY" or navigation data, or goes into the economy mode depending on menu setting. (More on menu operation later.)

Economy Mode

The CRT can be set to automatically turn itself off (through the "Mode & Function" menu) when in stand-by to reduce power consumption. This feature is called the "economy mode." Power consumption in the economy mode is 28W.

Navigation Data Display During Stand-by

Navigation data, input by external navaid, can be displayed during stand-by. (Navigation input required.) Figure 1-3 shows a typical navigation data display during stand-by.

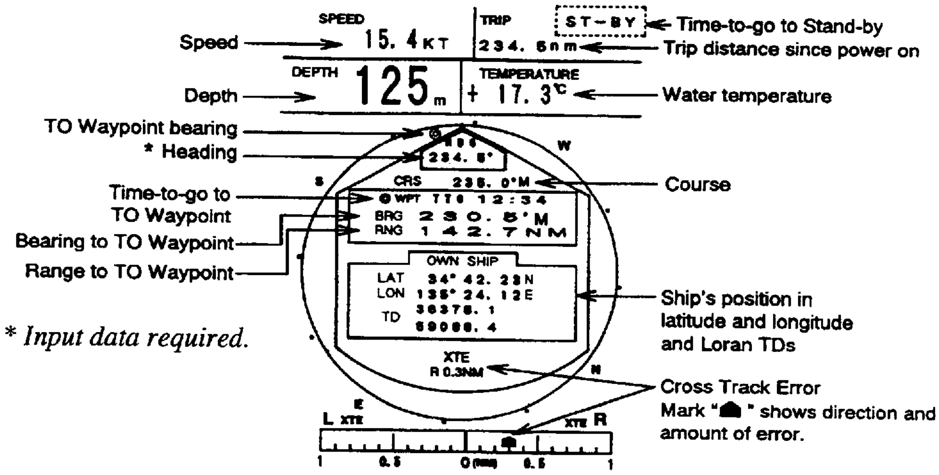


Figure 1-3 Typical navigation data display during stand-by

Notes on navigation data

- Availability of a particular display item depends on incoming data.
- When Range to Waypoint becomes 0.1 nm, the WPT mark jumps to dead ahead even though a difference may exist between heading and bearing to WPT.
- When cross track error exceeds 1 nm, "XTE" starts blinking.

Selecting a Range

The range selected automatically determines the range ring interval, the number of range rings and pulse repetition rate, for optimal detection capability in short to long ranges. You can select which ranges and pulselength (for 2 and 6 kilometer ranges) to use through the "Mode & Function" menu. The range, range ring interval and pulselength appear at the top left-hand corner of the display.

Tips for selecting range

- When navigating in or around crowded harbors, select a short range to watch for possible collision situations.
- If you select a lower range while on open water, increase the range occasionally to watch for vessels that may be heading your way.

Procedure

Press the **RANGE** key. Each time the range is changed the newly selected range appears momentarily at the center of the display for your confirmation. Range is always displayed at the top left corner on the screen.

Adjusting Receiver Sensitivity

The **GAIN** control adjusts the sensitivity of the receiver. It works in precisely the same manner as the volume control of a broadcast receiver, amplifying the signals received.

Procedure

The proper setting is such that the background noise is just visible on the screen. Adjust the sensitivity on the highest range; the background noise is clearer on that range. If you set up for too little sensitivity, weak echoes may be missed. On the other hand excessive sensitivity yields too much background noise; strong targets may be missed because of the poor contrast between desired echoes and the background noise on the display.

1) Transmit on long range.

2) Adjust the **GAIN** control so background noise is just visible on the screen.

Suppressing Sea Returns

Echoes from waves can be troublesome, covering the central part of the display with random signals known as "sea clutter." The higher the waves, and the higher the scanner above the water, the further the clutter will extend. Sea clutter appears on the display as many small echoes which might affect radar performance. (See the left-hand figure in Figure 1-4.) When sea clutter masks the picture, adjust the **A/C SEA** control to reduce the clutter.

How the A/C SEA control works

The **A/C SEA** control reduces the amplification of echoes at short ranges (where clutter is the greatest) and progressively increases amplification as the range increases, so amplification will be normal at those ranges where there is no sea clutter.

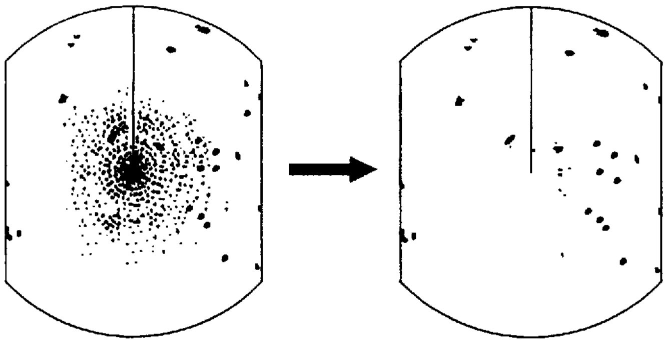
Adjustment of the A/C SEA control

The proper setting of the **A/C SEA** control should be such that the clutter is broken up into small dots, and small targets become distinguishable.

If the control is set too low, targets will be hidden in the clutter, while if it is set too high, both sea clutter and targets will disap-

pear from the display. In most cases adjust the control until clutter has disappeared to leeward, but a little is still visible windward.

1) Confirm that the sensitivity is properly adjusted, and then transmit on short range.
2) Adjust the **A/C SEA** control so small targets are distinguishable but some clutter remains on the display.



Sea clutter at display center. A/C SEA adjusted; sea clutter suppressed.

Figure 1-4 How to adjust the A/C SEA control

Tip for adjusting the A/C SEA

A common mistake is to over-adjust the circuit so all the clutter is removed. As an example set up for maximum A/C SEA. You will see how the center of the display becomes dark. This dark zone can be dangerous (targets may be missed), especially if the sensitivity is not properly adjusted. Always leave a little clutter visible on the display to be sure weak echoes will not be suppressed. If there is no clutter visible on the display, turn off the circuit.

Adjusting Display Brilliance

The **BRILL** key adjusts the brilliance of the display in sixteen levels including off. Each time the key is pressed the newly selected brilliance appears momentarily at the top of the display for your confirmation.

Erasing the Heading Mark

The heading mark continuously appears on the display and shows your vessel's heading. When this mark obscures a target echo, you can temporarily erase it by pressing and holding down the **GAIN** control. Release the control to re-display the heading mark.

About Tuning

The radar receiver can be tuned automatically or manually, and the default tuning method is automatic. In automatic tuning, the radar is automatically tuned everytime the radar is switched to "Tx" and the indication "TUNING" appears during tuning.

The tuning bar at the top right-hand corner of the display shows tuning condition. Generally, the longer the tuning bar the better the tuning condition, however the length of the bar changes with number of radar echoes, range and other factors. Current tuning method is shown above the tuning bar as either "AUTO" or "MANUAL."

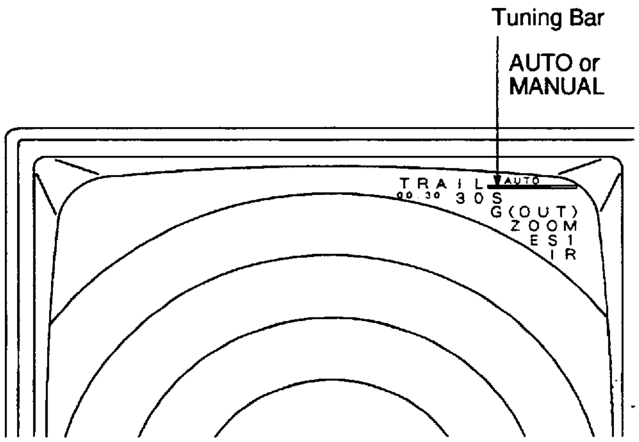


Figure 1-5 Tuning bar

For how to tune the radar manually, see "5. Tuning" on page 1-10.

NOTE: *Automatic tuning may not work properly if own ship's radar receives the radar wave of another ship's radar. If this is the case, the radar will be out of tune. Press the* **STBY TX** *twice to retune.*

The Menu

The main menu, consisting of seven menus, contains less-often used functions which once preset do not require regular adjustment. To display or close the menu, press the **MENU** key. You can select menus, sub menus and options by the trackball. Note that the menu can also be displayed (and options selected) while the radar is in stand-by.

[MAIN MENU]
Select item by trackball and press ENTER key.

1. Backlight/Brilliance
2. P/L & Int/Noise Rej
3. Nav Data
4. Mode & Function
5. Tuning AUTO MANUAL
6. Self Check
7. Installation Setup 1

Press GAIN to temporarily hide menu.

<Press MENU key to escape.>

Figure 1-6 Main menu

Menu description

Table 1-1 Main menu description

Menu	Sub Menu	Function
1. Backlight/Brilliance	1. Panel	Adjust panel backlighting.
	2. Heading Mark	Adjust brilliance of heading mark.
	3. Other Marks	Adjust brilliance of VRM, EBL, cursor, guard zone and waypoint.
	4. Characters	Adjust brilliance of characters. Note that the brilliance of levels 1 and 2 are the same while the menu is displayed.
	5. Echo Trails	Adjust brilliance of echo trails.
2. P/L & Int/Noise Rej	1. Pulselength	Select pulselength for 2 and 6 kilometer ranges.
	2. Int Reject	Select level of interference rejection.
	3. Noise Reject	Select level of noise rejection.
3. Nav Data	1. Navigator	Select source of navigation data.
	2. Nav Data Disp	Turn navigation data display on/off.
	3. Pos Disp Mode	Display position in lat/long or Loran TD.

Menu	Sub Menu	Function
3. Nav Data (cont.)	4. Depth Unit	Select depth unit for meter, feet, or fathom.
	5. Temp. Unit	Select unit of water temperature measurement for °C or °F.
4. Mode & Function	1. STBY Display	Select function at stand-by. Display "ST-BY" or navigation data, or go into economy mode.
	2. Watchman	Turn watchman on /off. Tx interval is available in 5, 10 or 20 minutes.
	3. Alarm Mode	Select condition which triggers guard alarm; in (target enters guard zone) or out (target exits guard zone).
	4. VRM Unit	Select unit of measurement for VRM and cursor for nm, km, or sm.
	5. EBL Ref	Select EBL reference for relative or true (true bearing requires NMEA heading input).
	6. Range	Select useable ranges.
5. Tuning	AUTO, MANUAL	Select automatic or manual tuning. To tune manually; 1. Select MANUAL by trackball. 2. Press the ENTER key. 3. While pressing and holding down the GAIN control, operate the trackball to tune. 4. Press the ENTER key.
6. Self Check		Test controls, ROM and RAM; display program no., Tx hours and radar on hours.
7. Installation Setup 1 and 2 menus	These menus are for use by service technicians. They cannot be accessed during normal operation.	

Menu operation

1) Press the **MENU** key to display the main menu.

2) Operate the trackball to select a menu; for example, the Backlight/Brilliance menu. As you move the highlighted cursor down through the menu, each menu number, initially shown in white on green, inverses to green on white. This shows the associated menu is available for selection. Further, menu selection guidance appears at the bottom of the menu window.

3) Press the **ENTER** key. Figure 1-7 shows the Backlight/Brilliance menu.

【 BACKLIGHT/BRILLIANCE MENU 】

Select item and option by trackball.

1.	Panel	1	2	3	4
2.	Heading Mark	1	2	3	4
3.	Other Marks	1	2	3	4
4.	Characters	1	2	3	4
5.	Echo Trails	1	2		

Press GAIN to temporarily hide menu.

<Press MENU for main menu.>

Figure 1-7 Backlight/brilliance menu

4) Roll the trackball vertically to select sub menu.

5) Roll the trackball horizontally to select option. Current settings are shown in inverse video.

6) Press the **MENU** key twice to close the menu.

Measuring Range

In the basic radar system your ship is in the center of the display, and any target received appears in a map-like projection throughout 360 degrees. This allows the range and bearing from your vessel to a target appearing on the display to be measured.

You can measure the range to a target three ways:

- by the range rings
- by the cursor, and
- by the VRM (Variable Range Marker).

Measuring range by range rings

To get a rough measurement of the range to a target, use the range rings. Press the **RINGS** key to turn on the range rings. Further pressing of the key adjusts their brilliance or turns them off. Each time the key is pressed the newly selected brilliance level appears momentarily at the top of the display for your confirmation.

To measure range by the range rings, count the number of rings between the center of the display and the target. Check the range ring interval and judge the distance of the echo from the inner edge of the nearest ring.

Measuring range by cursor

To measure range by the cursor, rotate the trackball to place the cursor intersection on the inside edge of the target. The range to the cursor intersection appears at the bottom of the display. (Cursor range/bearing and cursor position are alternately displayed by pressing the **ENTER** key.)

Measuring range by VRM

1) Press either the **VRM1** or **VRM2** key. The readout of the active marker is circumscribed.



Figure 1-8 Display bottom, showing location of EBL and VRM readouts

2) Operate the trackball to place the outside edge of the VRM on the inside edge of the target.

3) Check the VRM readout at the bottom right-hand corner of the display to find the range to the target.

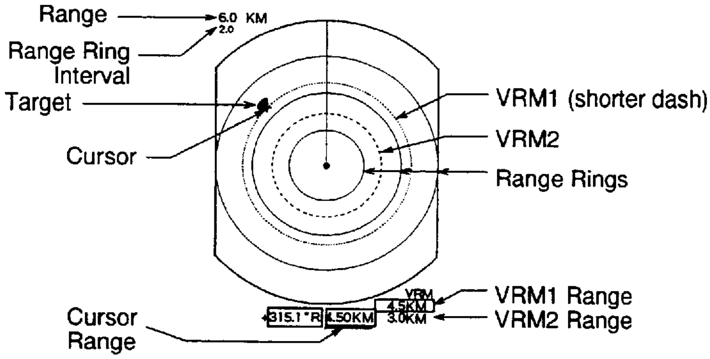


Figure 1-9 How to measure bearing by cursor, range rings and VRM

Erasing active VRM

Press and hold down corresponding VRM key about two seconds.

Unit of range measurement for VRM and cursor

The VRM and cursor ranges can be displayed in nautical miles or kilometers with the **NM/KM** key.

Measuring Bearing

There are three ways to measure the bearing to a target:

- by the bearing scale (rough estimate)
- by the cursor, and
- by the EBL (Electronic Bearing Line).

Measuring bearing by cursor

Rotate the trackball to set the cursor intersection on the center of the target. The bearing to the cursor intersection appears at the bottom of the display. (Cursor range/bearing and cursor position are alternately displayed by pressing the **ENTER** key.)

Measuring bearing by EBL

1) Press the **EBL1** or **EBL2** key.

2) Operate the trackball to bisect the target with the EBL.

3) Check the EBL readout at the bottom left-hand corner of the display to find the bearing to the target.

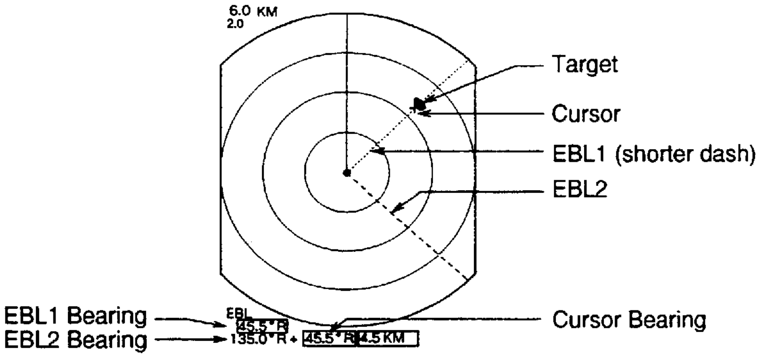


Figure 1-10 How to measure bearing by EBL and cursor

Erasing active EBL

Press and hold down corresponding EBL key about two seconds.

Displaying true or relative bearing

The bearing readout for the EBL and the cursor can be displayed in relative or true bearing (true bearing requires heading sensor input), through the "Mode & Function" menu.

Tips for measuring bearing

- Bearing measurements of smaller targets are more accurate; the center of larger target pips is not as easily identified.
- Bearings of stationary or slower moving targets are more accurate than bearings of faster moving targets.
- To minimize bearing errors keep echoes in the outer half of the picture by changing the range scale; angular difference becomes difficult to resolve as a target approaches the center of the display.

Collision Assessment by the Offset EBL

The origin of the EBL can be placed anywhere with the trackball to measure range and bearing between any two targets, as well as to assess the risk of collision.

Procedure

1) Turn on EBL1.
2) Press the **EBL OFFSET** key. EBL1's origin shifts to cursor location.
3) Operate the trackball to place EBL1's origin (cursor) on the center of the target.
4) Press the **EBL1** key.
5) Operate the trackball to pass EBL1's origin through the center of the display.
6) Wait several minutes. If the target tracks along EBL1 towards the center of the display (your vessel's position), it may be on a collision course with own vessel.

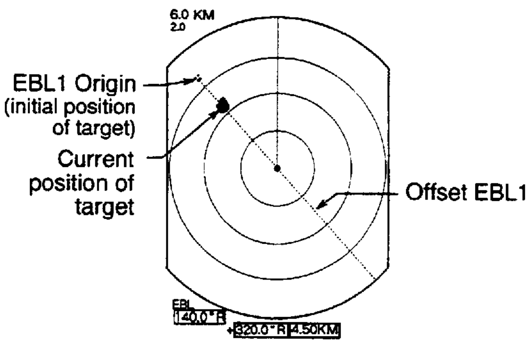


Figure 1-11 Assessing risk of collision by using the offset EBL

Canceling the offset EBL

Press the **EBL OFFSET** key.

Measuring Range and Bearing Between Two Targets

The procedure which follows shows how to measure the range and bearing between target "A" and target "B" in Figure 1-12.

Procedure

1) Turn on EBL1.
2) Turn on VRM1.
3) Press the **EBL OFFSET** key. EBL1's origin shifts to cursor location.
4) Operate the trackball to place EBL1's origin (cursor) on the center of target "A."
5) Press the **EBL1** key.
6) Operate the trackball to bisect target "B" with EBL1. Check the EBL1 readout to find the bearing between target "A" and target "B."
7) Press the **VRM1** key. Operate the trackball to place the outside edge of VRM1 on the inside edge of target "B." Check the VRM1 readout to find the range between target "A" and target "B."

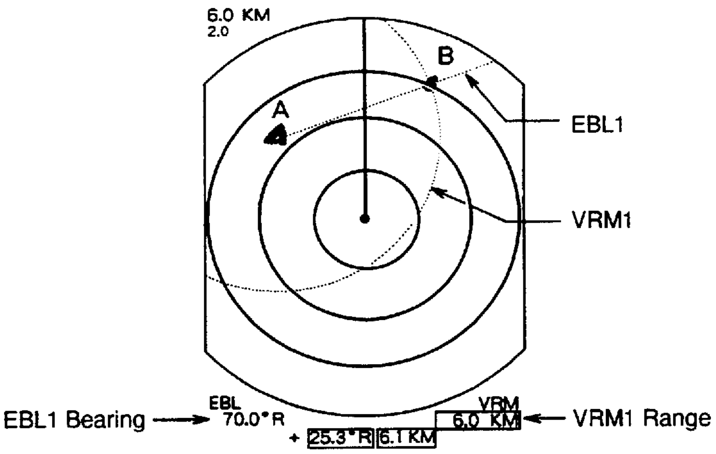


Figure 1-12 Measuring the range and bearing between two targets by using the offset EBL

Canceling the offset EBL

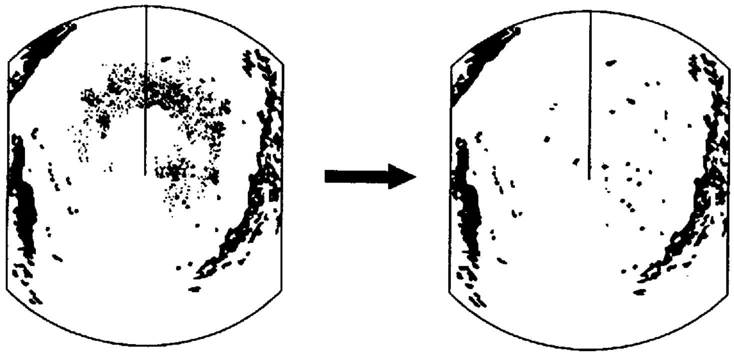
Press the **EBL OFFSET** key.

Suppressing Precipitation Returns

The vertical beamwidth of the scanner is designed to see surface targets even when the ship is rolling. However, by this design the unit will also detect precipitation (rain, snow, or hail) in the same manner as normal targets. Figure 1-13 shows the appearance of precipitation on the display.

How to suppress precipitation returns

- **When only a slight amount of clutter is visible on the display,** raise the **A/C RAIN** control setting slightly to distinguish targets from the clutter.
- **In heavy storms or partial clutter,** push in the **A/C RAIN** control to activate the FTC (Fast Time Constant) circuit. This circuit splits up unwanted echoes into a speckled pattern to distinguish solid targets from the clutter.



Precipitation clutter at central part of display.

A/C RAIN adjusted; precipitation clutter suppressed.

Figure 1-13 Effect of A/C RAIN control

Other uses of the A/C RAIN

In addition to reducing precipitation clutter, the **A/C RAIN** control can be used in fine weather to clarify the picture when navigating in confined waters. However, with the circuit activated the receiver is less sensitive. Therefore, turn the control fully counterclockwise (off) when its function is not required.

Suppressing Radar Interference

Radar interference may occur when near another marine radar operating in the same frequency band as your radar. Its on-screen appearance is many bright dots either scattered at random or in the form of dotted lines extending from the center to the edge of the display. Figure 1-14 illustrates interference in the form of "curved spokes." Interference effects are distinguishable from normal echoes because they do not appear in the same place on successive rotations of the scanner.

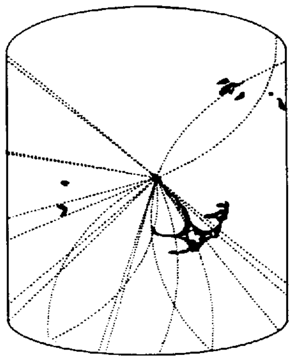


Figure 1-14 Radar interference

To reduce radar interference;

1) Press the **MENU** key to display the menu.
2) Operate the trackball to select "2. P/L & Int/Noise Rej."
3) Press the **ENTER** key.
4) Operate the trackball to select "2. Int Reject."
5) Operate the trackball to select level of interference rejection. ("IR" and level selected appear at bottom right-hand corner of the display.)
6) Press the **MENU** key twice to close the menu.

Enlarging an Area of Interest

The zoom feature allows you to double the size of the area between your vessel and any location within the current range to take a closer look at an area of interest without changing the range.

Procedure

1) Select location with the cursor.

2) Press the **ZOOM** key.

"ZOOM" (blinking) appears at the top right-hand corner when the zoom function is on.

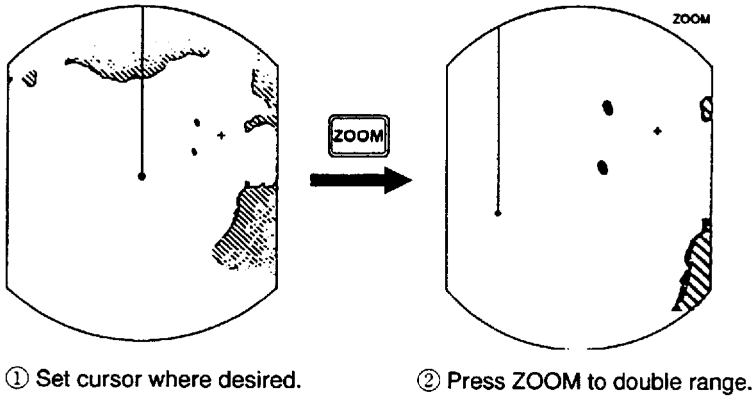


Figure 1-15 Zoom function

NOTE 1: *The zoom function is inoperative when the display is shifted.*

NOTE 2: *If the cursor is not positioned within the current range when the* **ZOOM** *key is pressed, several beeps are emitted and the outermost range ring blinks twice, even if the range rings are off. Reposition the cursor and press the key again.*

Canceling zoom

Press the **ZOOM** key again.

Shifting the Picture

Your vessel's position can be shifted to view ahead or behind your vessel without changing the range or size of targets.

Procedure

1) Operate the trackball to set cursor where desired.

2) Press the **OFF CENTER** key.

"OFF CENTER" appears at the top right-hand corner of the display when the picture is shifted.

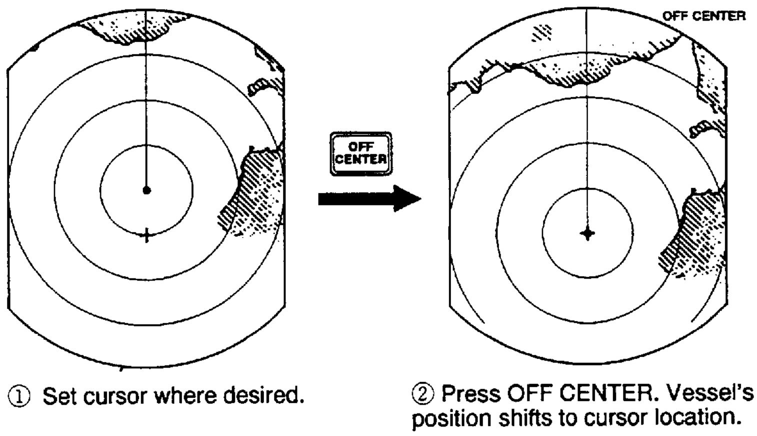


Figure 1-16 Shifting the picture

Canceling off center picture

Press the **OFF CENTER** key again.

Guard Alarm

The guard alarm allows the operator to set the desired range and bearing for a guard zone. When ships, islands, landmasses, etc. violate the guard zone an aural alarm sounds and the offending target blinks to call the operator's attention.

Selection of guard zone type

The guard alarm can be set to sound when a target either enters or exits the guard zone. You can select which type of guard alarm you want to use through the "Mode & Function" menu.

In alarm

The alarm sounds on targets entering the guard zone. "G (IN)" appears at the top right-hand corner when the In alarm is selected.

Out alarm

The alarm sounds on targets exiting the guard zone. "G (OUT)" appears at the top right-hand corner when the Out alarm is selected.

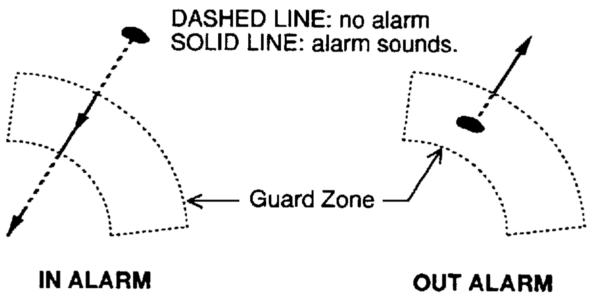


Figure 1-17 In and out alarms

To select guard zone type;

1) Press the **MENU** key, and then select "Mode & Function" by operating the trackball and pressing the **ENTER** key.
2) Select "3. Alarm Mode" and "In" or "Out" by operating the trackball.
3) Press the **ENTER** key.
4) Press the **MENU** key twice to close the menu.

Setting a guard zone

1) Mentally create the guard zone you want to set.

2) Referring to (1) in Figure 1-18, operate the trackball to set the cursor on point A or B. Press the **GUARD ALARM** key. "*G (IN)" or "*G (OUT)," with asterisk blinking, appears at the top right-hand corner of the display. See Figure 1-18 (2). (The asterisk indicates the guard zone is partially set.)

3) Operate the trackball to set the cursor on point C or D. See Figure 1-18 (3).

4) Press the **GUARD ALARM** key. The asterisk disappears. See Figure 1-18 (4).

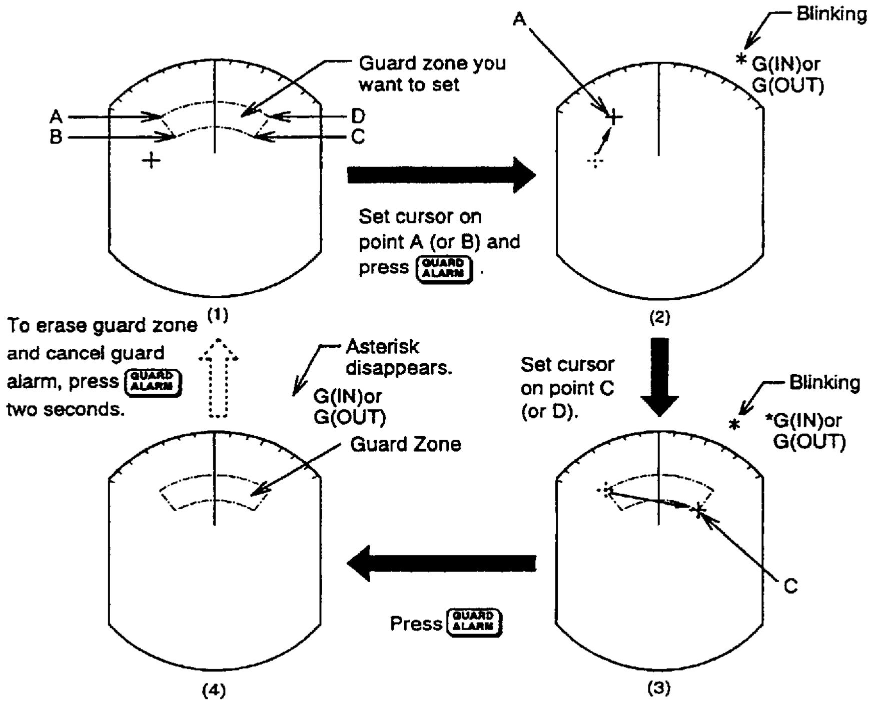


Figure 1-18 How to set the guard zone

Silencing the aural alarm

Any radar targets violating the guard zone will trigger the aural alarm. You can silence the alarm by pressing the **GUARD ALARM** key. When this is done, "G (ACKN)" replaces "G (IN)" or "G (OUT)." This means the alarm is temporarily deactivated. Press the key again to reactivate the alarm.

Canceling the guard zone and guard alarm

Press and hold down the **GUARD ALARM** key until the guard zone disappears.

Notes on the guard alarm

- The alarm is a useful anticollision aid, but does not relieve the operator of the responsibility to also keep a visual lookout for possible collision situations. The alarm should not be relied upon as the sole means for detecting possible collision situations.
- When the radar range is less than one half of the guard zone range, the guard zone disappears and "G (IN)" ("G (OUT)") appears in inverse video. If this happens, raise the range to re-display the guard zone.
- A target echo does not always mean a landmass, reef, ships or surface objects but can imply returns from sea surface or precipitation. As the level of these returns varies with environment, the **A/C SEA**, **A/C RAIN** and **GAIN** should be properly adjusted to be sure the alarm system does not overlook target echoes.
- The minimum echo strength which triggers the alarm can be selected through the "Installation Setup 1" menu.

Trailing Target Movement

You can show the movement of all radar targets relative to your vessel in afterglow. This function is useful for alerting you to possible collision situations.

Starting echo trailing

Press the **ECHO TRAIL** key to start echo trailing. Press the key again within three seconds to select echo trailing time, namely, trail length in minutes. Trailing time is available in 15 seconds, 30 seconds, 1 minute, 3 minutes, 6 minutes, 15 minutes, 30 minutes, and continuous. "TRAIL," the echo trailing time selected and elapsed time appear at the top right-hand corner of the display. Then, afterglow starts extending from all targets.

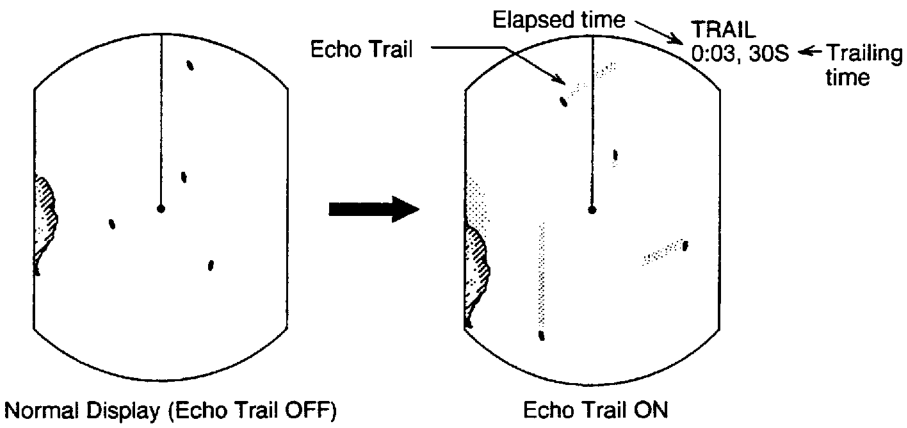


Figure 1-19 How the echo trail feature works

NOTE: *If the range or mode is changed or the off center or zoom is turned on during echo trailing, trailing is restarted.*

Canceling echo trailing

Press the **ECHO TRAIL** key.

What occurs during trailing

Fixed time trailing

1) When the elapsed time clock counts up to the trailing time selected, the elapsed time display freezes.
2) The oldest portions of trails are erased so only the latest trail, equal in length to the trailing time selected, is shown.
3) Trailing continues.

For example, the one minute trailing time is selected. When the elapsed time clock counts up to 60 seconds, the elapsed time display freezes at "60," all but the latest one minute of trails are erased, and then trailing continues.

Continuous trailing

The maximum continuous trailing time is 99 minutes and 59 seconds. When the elapsed time clock counts up to that time the elapsed time display is reset to zero and trailing begins again.

Adjusting brilliance of afterglow

The brilliance of the afterglow can be set for high or low on the "Backlight/Brilliance" menu.

Displaying Navigation Data

Navigation data can be displayed at the screen bottom if this radar receives navigation input in NMEA 0183 format. Navigation data include

- position in latitude and longitude or Loran-C time differences (one can be selected on the "Nav Data" menu)
- range, bearing and time-to-go to both waypoint (selected on external navaid) and the cursor
- speed, and
- course.

If the navigation input includes destination data, waypoint position is denoted on the radar display by a dashed ring.

Turning navigation data on or off

Press the **NAV** key.

Notes on navigation data

- "NO DATA" appears when no navigation data is received or wrong navaid is selected on the menu.
- TTG data is displayed by asterisks when there is no waypoint data.

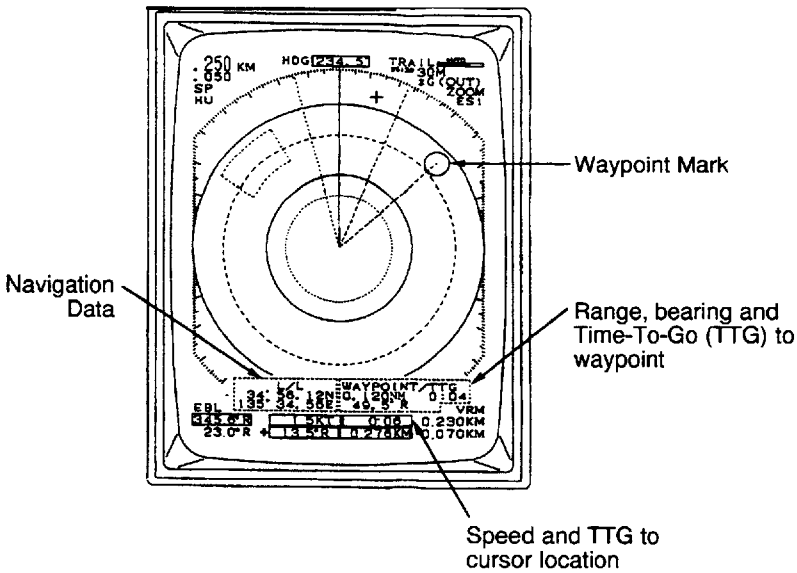


Figure 1-20 Typical navigation data display

Outputting Cursor Position to External Equipment

Press and hold down the **ENTER** key about two seconds.

Magnifying Long Range Echoes

Normally, the reflected echoes from long range targets appear on the display as weaker and smaller blips even though they are compensated by the radar's internal circuitry. The echo stretch function magnifies these small blips in all ranges to make them easier to see. Two types of echo stretch are available: ES1 which stretches echoes in bearing direction, and ES2 which stretches them in both range and bearing directions.

Turning the echo stretch on or off

Press the **A/C SEA** control. Each press changes the echo stretch function in the sequence of ES1, ES2 and OFF. ES1 or ES2 appears at the top right-hand corner of the display when echo stretch is on.

NOTE: *This function magnifies not only targets but also sea clutter and radar interference. For this reason be sure sea clutter and radar interference are properly suppressed before turning on the echo stretch.*

Watchman

The watchman function periodically transmits the radar for one minute to check for targets in a guard zone. If it finds change in the zone from the previous transmission it sounds the aural alarm, cancels the watchman function, and transmits the radar continuously. This feature is useful when you do not need the radar's function continuously but want to be alerted to radar targets in a specific area.

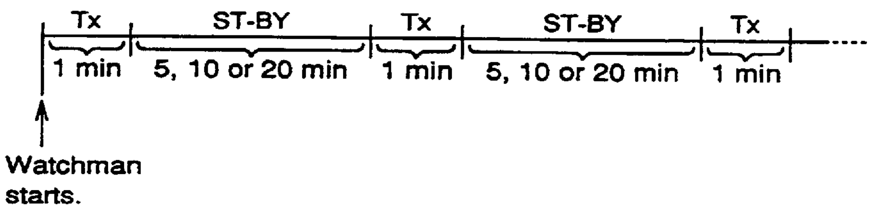


Figure 1-21 How watchman works

Turning on watchman

1) Create a guard zone (usually 360 degrees) with the guard alarm function.
2) Press the **MENU** key.
3) Operate the trackball to select "Mode & Function."
4) Press the **ENTER** key.
5) Operate the trackball to select "2. Watchman."
6) Operate the trackball to select watchman rest period; 5 minutes, 10 minutes or 20 minutes.
7) Press the **ENTER** key.
8) Press the **MENU** key twice to close the menu.

"WATCHMAN" appears at the top of the screen, the radar transmits for one minute to check for targets inside the guard zone, and then the CRT shuts off and the radar goes into stand-by.

NOTE 1: *Watchman can be used without a guard zone.*

NOTE 2: *The alarm sounds just before the radar starts and stops transmitting.*

Canceling watchman

Go into the "Mode & Function" menu, and set "2. Watchman" for OFF.

Displaying Index Lines

Index lines (max. six lines) can be turned on/off by pressing the **INDEX** key. The index lines are useful for maintaining a constant distance between own ship and a coastline or partner ship. They can be rotated by EBL2 and their width changed by VRM2.

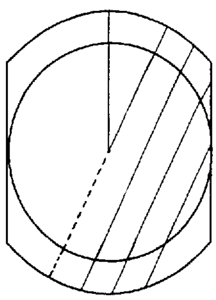


Figure 1-22 Index lines

Remote Controller

The remote controller provides armchair control of three functions: range, off center, and transmission/stand-by. Operation is the same as corresponding controls on the display unit.

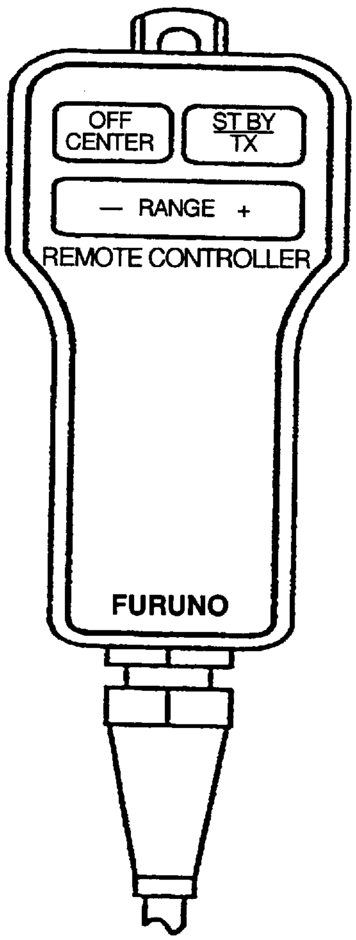


Figure 1-23 Remote controller

Displaying Cursor Range and Bearing, Cursor Position

The **ENTER** key displays cursor range and bearing and cursor latitude and longitude position alternately, at the bottom of the display. (When there is no heading data, asterisks appear instead of cursor latitude and longitude indication, even if nav data is input.)

Display Indications

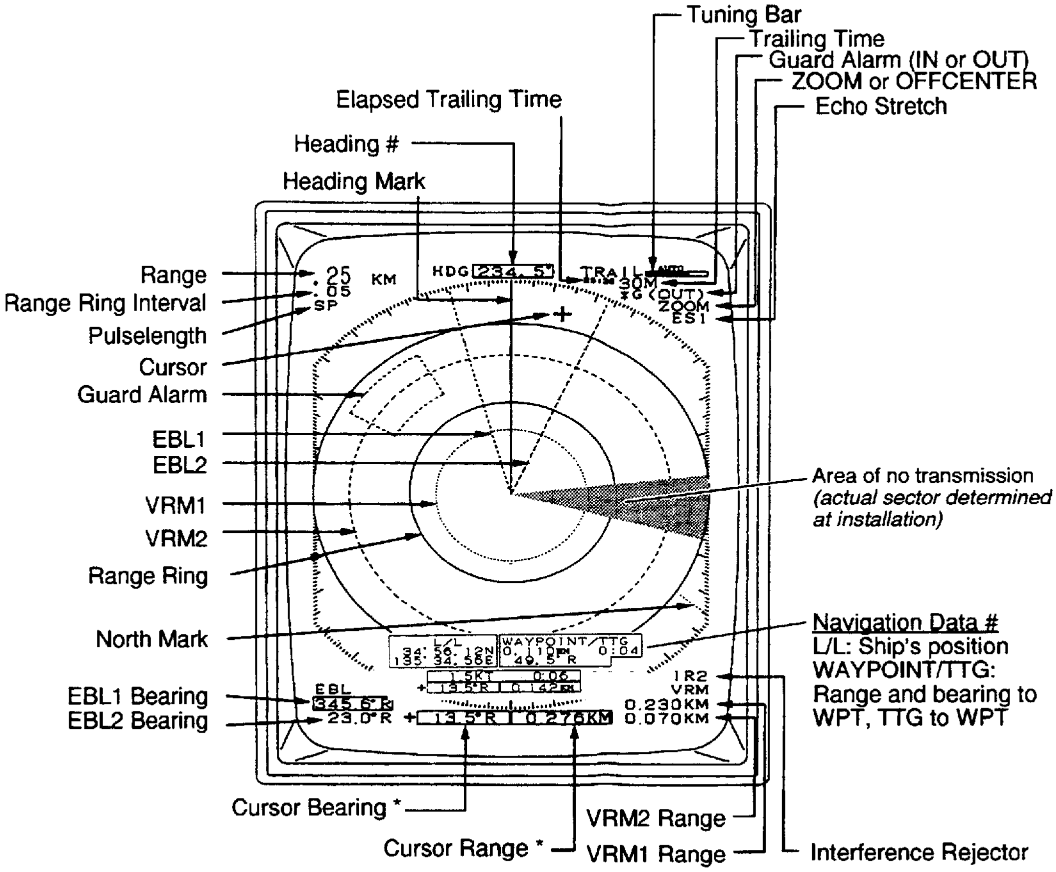


Figure 1-24 Display indications and marks

* *Cursor range and bearing and L/L position alternately displayed by* **ENTER** *key.*

Heading display requires heading input. Nothing appears when there is no heading input.

2. Performance and Interpretation

Overview

As an aid to navigation, radar can be a very valuable tool. No other navigation aid can give you the ability to spot vessels coming at you in the fog, or tell you the location of the inlet to the harbor in the pitch black of night.

To help you understand better what your radar can (and cannot) do for you this chapter covers

- the characteristics of the radar wave
- target properties and radar wave reflection
- range and bearing resolution, and
- false echoes.

The Radar Wave and Radar Horizon

How the radar wave travels

The radar wave tends to travel in straight lines at the speed of light. However, it is subject to bending or refraction in the atmosphere, the amount depending on region and density.

Super-refraction

Super-refraction is a condition in which there is an upper layer of warm dry air over a surface layer of cold, moist air. Radar waves bend downward and thus increase the ranges at which targets may be detected.

Sub-refraction

Sub-refraction is the reverse condition of super-refraction; a layer of cold air is above a layer of warm air. Radar waves bend upward and thus decrease the ranges at which targets may be detected.

Radar horizon

Radar is essentially a "line-of-sight" phenomenon. That means you have just about the same range to horizon with a radar as you do with your own eyes. However under normal atmospheric conditions, the radar horizon is 6% greater than the optical horizon. Therefore, if the target does not rise above the horizon the radar beam cannot be reflected from the target.

The distance to the horizon from the scanner, under normal conditions, is calculated by the following formula.

$$Rmax = 4.12 \times (\sqrt{h1} + \sqrt{h2})$$

Where Rmax: Radar horizon (kilometers), h1: Antenna height (meters), h2: Target height (meters)

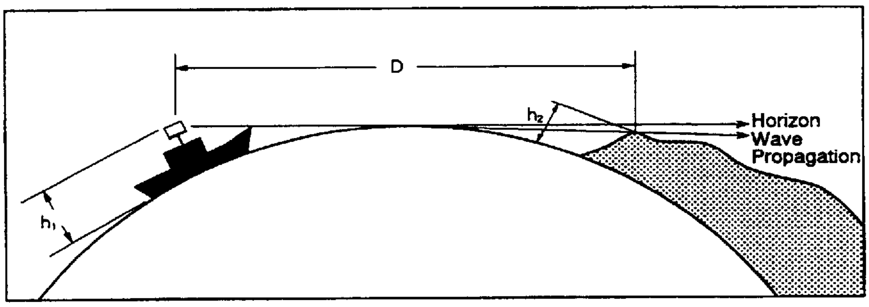


Figure 2-1 Radar horizon

Target Properties and Radar Wave Reflection

Generally, larger targets can be seen on the radar display at greater ranges, provided line-of-sight exists between the scanner and target. However, a large target with poor reflecting properties may not be detected as easily as a smaller target with better reflecting properties. For example, you might expect a lighthouse to be a good radar target because of its size. In actuality the return echo is weak since the conical shape diffuses most of the radiated energy.

A ship whose hull is made of conducting materials, such as steel, will return a relatively strong echo.

On the other hand, hulls made from wood or fiberglass return much weaker echoes.

Vertical surfaces, such as a cliff, are good targets provided they face the radar. Conversely, horizontal and smooth surfaces such as mudbanks, sandy beaches, and gently sloping hills make poor

targets because they disperse rather than reflect most of the energy that strikes them.

The strongest radar echoes known come from built-up areas, docks, etc., because these targets are less subject to changes in aspect. These types of targets have three flat, smooth surfaces mutually at right angles. Some radar buoys are arranged this way so as to deliberately increase their detection range.

Range Resolution

Range resolution is a measure of the capability of a radar to display as separate pips the echoes received from two targets which are on the same bearing and are close together.

The main factor which affects range resolution is pulselength. Two targets on the same bearing, close together, cannot be seen as two distinct echoes on the display unless they are separated by a distance greater than one-half the pulselength.

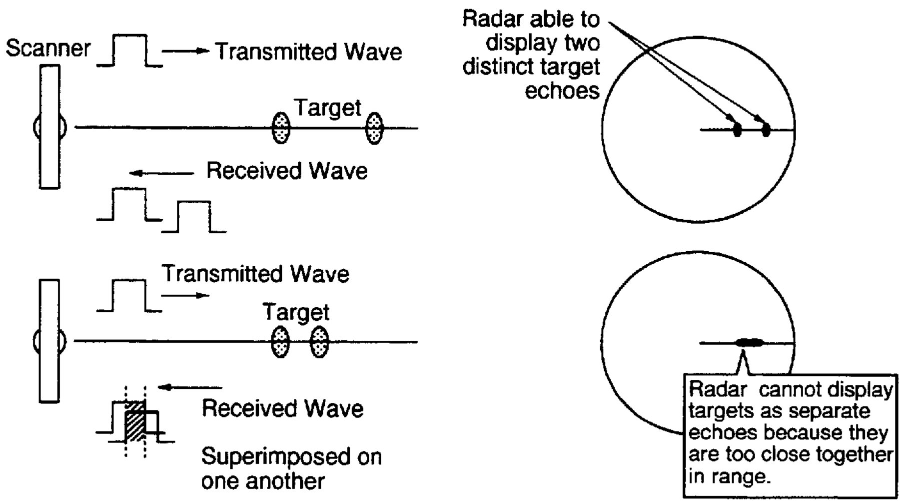


Figure 2-2 Range resolution

Bearing Resolution

Bearing resolution is a measure of the capability of a radar to display as separate targets the echoes received from two targets which are at the same range and are close together.

The principal factor which affects bearing resolution is horizontal beamwidth. Two targets at the same range must be separated by more than one beamwidth to appear as separate pips.

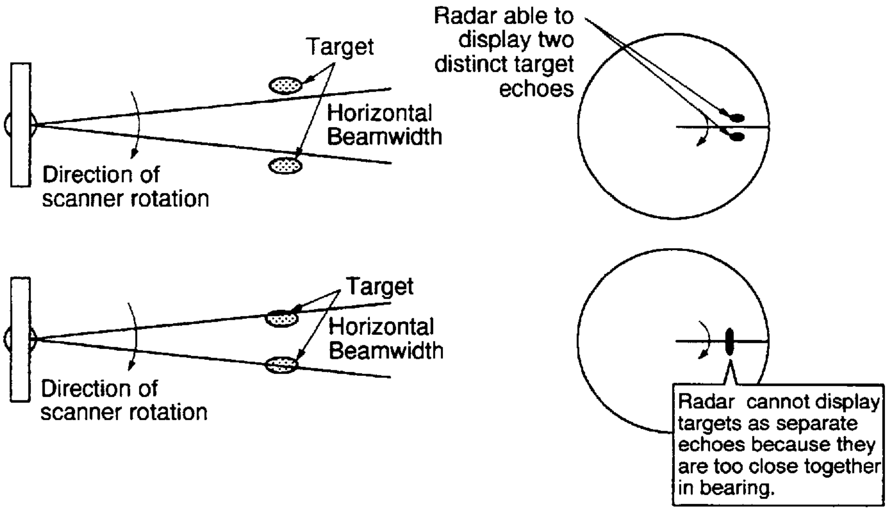


Figure 2-3 Bearing resolution

False Echoes

Occasionally false echoes appear on the screen at positions where there is no target. In some cases the effects can be reduced or eliminated. The operator should familiarize himself or herself with the appearance and effects of these false echoes, so as not to confuse them with echoes from legitimate contacts.

Multiple echoes

Multiple echoes occur when a short range, strong echo is received from a ship, bridge, or breakwater. A second, a third or more echoes may be observed on the display at double, triple or other multiples of the actual range of the target as shown in Figure 2-4. Multiple echoes can be reduced and often removed by decreasing the sensitivity or properly adjusting the A/C SEA.

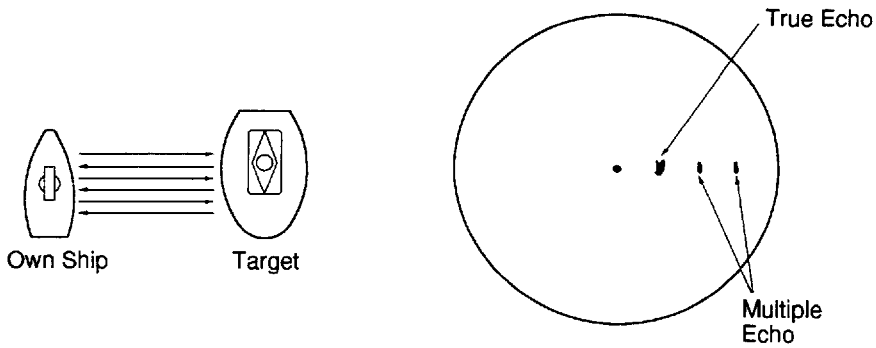


Figure 2-4 Multiple echoes

Side-lobe echoes

Every time the scanner rotates, some radiation escapes on each side of the beam. This radiation is called "side-lobes." If a target exists where it can be detected by the side-lobes as well as the main-lobe, the side-lobe echoes may be represented on both sides of the true echo at the same range, as shown in Figure 2-5.

Side-lobes show usually only at short ranges and from strong targets. They can be reduced through careful reduction of the sensitivity or proper adjustment of the A/C SEA.

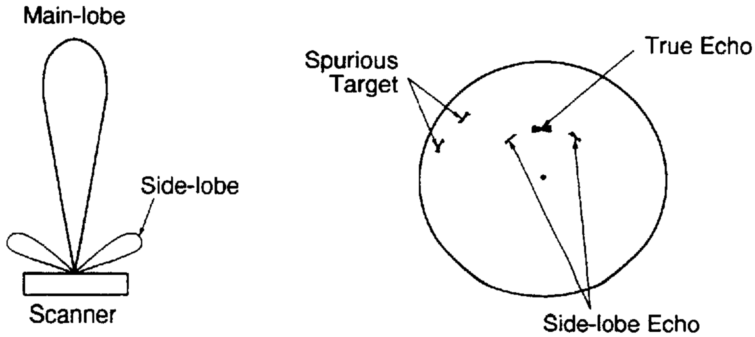


Figure 2-5 Side-lobe echoes

Blind and shadow sectors

Funnels, stacks, masts, or derricks in the path of antenna may reduce the intensity of the radar beam. If the angle subtended at the scanner is more than a few degrees a blind sector may be produced. Within the blind sector small targets at close range may not be detected while larger targets at much greater ranges may be detected. See Figure 2-6.

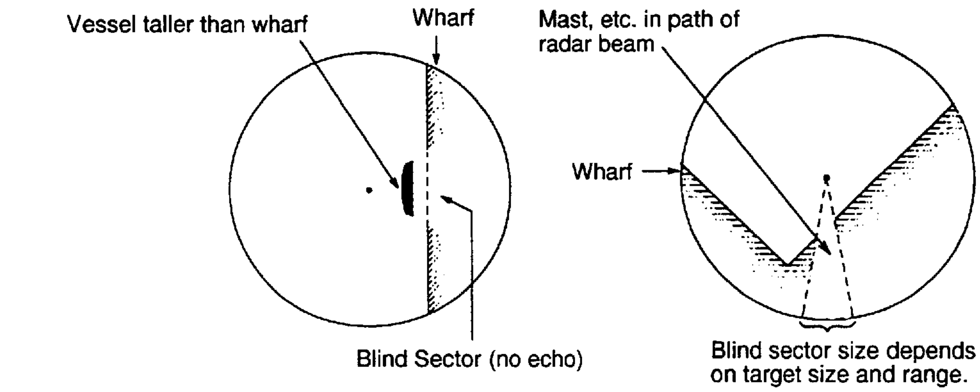


Figure 2-6 Blind and shadow sectors

Indirect echoes

Indirect echoes may be returned from either a passing ship or returned from a reflecting surface on your own ship, for example, a stack. In both cases, the echo will return from a legitimate contact to the antenna by the same indirect path. The echo will appear on the same bearing of the reflected surface, but at the same range as the direct echo. Figure 2-7 illustrates the effect of an indirect echo. Indirect echoes may be recognized as follows:

- they usually occur in a shadow sector
- they appear on the bearing of the obstruction but at the range of the legitimate contact
- when plotted, their movements are usually abnormal, and
- their shapes may indicate they are not direct echoes.

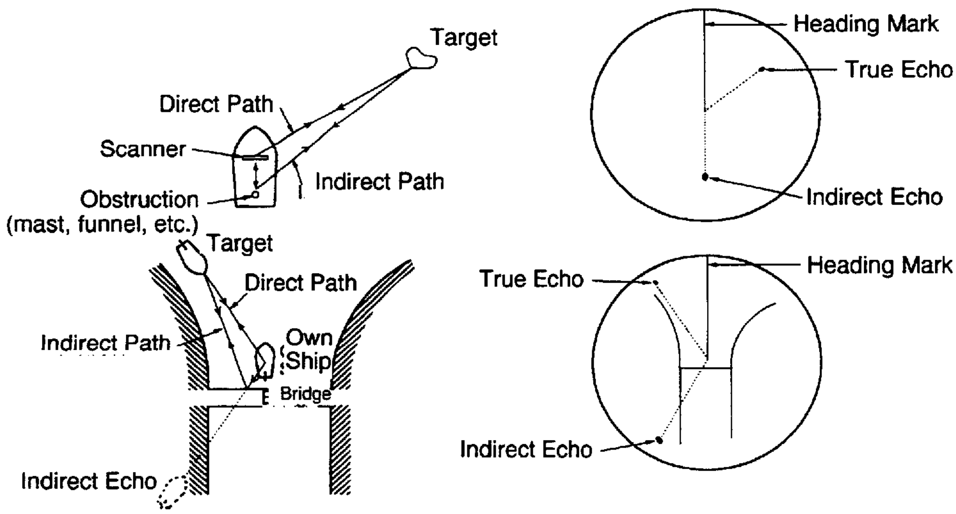
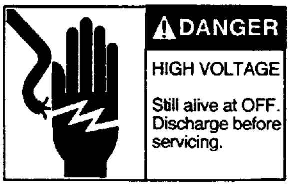


Figure 2-7 Indirect echoes

Precautions

This chapter tells you how to keep your radar in good working order. Before reviewing this chapter please read the safety information which follows.



ELECTRICAL SHOCK HAZARD

This equipment uses high voltage electricity which can endanger human life. At several places in the unit there are high voltages sufficient to kill anyone coming in direct contact with them. While the equipment has been designed with consideration for the operator's safety, precautions must always be exercised when reaching inside the equipment for the purpose of maintenance or service. For this reason, only qualified personnel totally familiar with electrical circuits and service manual should work inside the display unit or scanner unit.



Turn off the radar before servicing scanner unit

Turn off the radar before servicing the scanner unit.

Maintenance Program

Regular maintenance is important for good performance. Always keep the equipment as free as possible from dirt, dust, and water splashes. Make sure all screws securing the components are properly tightened.

A maintenance program should be established and should at least include the items listed in Table 3-1.

Table 3-1 Maintenance program

Period	Item	Check Point	Remarks
3 to 6 months	Scanner unit fixing bolts	Check for tightness and corrosion.	Replace corroded bolts. Apply coat of anti-corrosive sealant to new bolts.
	Radiator cleanliness	Foreign material (salt, oil, etc.) on the radiator will cause a considerable drop in radar performance. Clean the radiator with a freshwater-moistened cloth.	The only recommended cleaning agent is alcohol.
	Antenna connectors	Open the scanner unit and visually check all connectors for proper seating and corrosion.	
	CRT	The CRT will, in time, accumulate a coating of dust which tends to dim the picture. Wipe the CRT lightly with a soft cloth.	DO NOT use chemical cleaners to clean any part of the display unit. They may remove paint and markings.
6 months to 1 year	CRT anode and approach	High tension on the CRT attracts dust, and moist dust will cause poor insulation.	***Have a qualified service technician clean the CRT anode and approach. See Figure 3-2.***
1 year	Connectors on rear panel of display unit	Check for proper seating and corrosion.	See Figure 3-3.

Replacing the Fuse

The 10A (24V/32V) or 15A (12V) fuse on the rear panel of the display unit protects the equipment against reverse polarity of ship's mains, overcurrent, and equipment fault. If the fuse blows, find the cause before replacing it. Never use a fuse rated for more than 10A (or 15A), since use of the wrong fuse can cause serious damage to the equipment and void the warranty.

Location of Parts

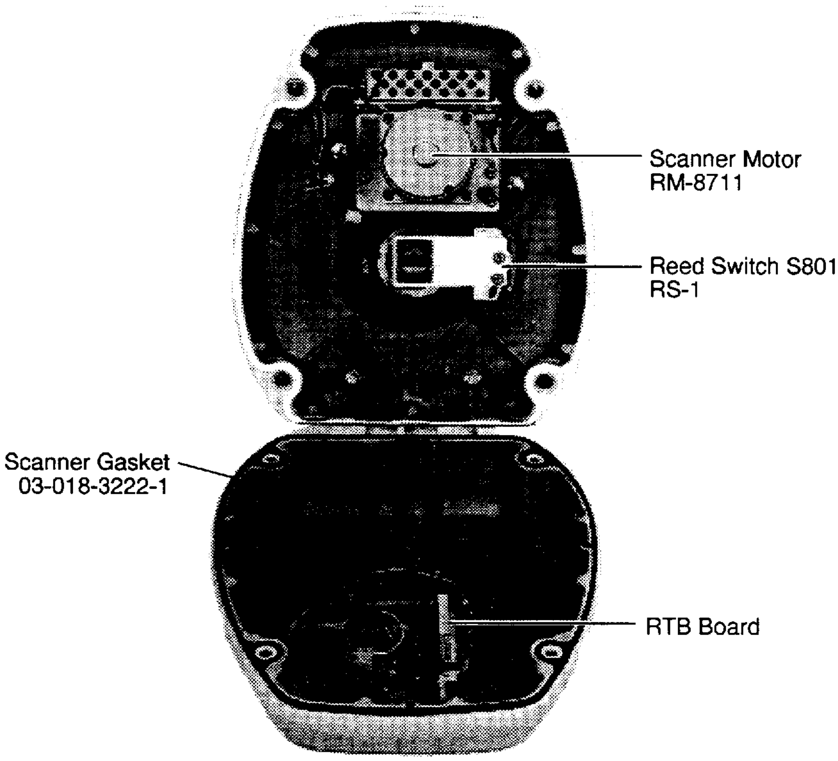


Figure 3-1 Scanner unit, radome cover opened

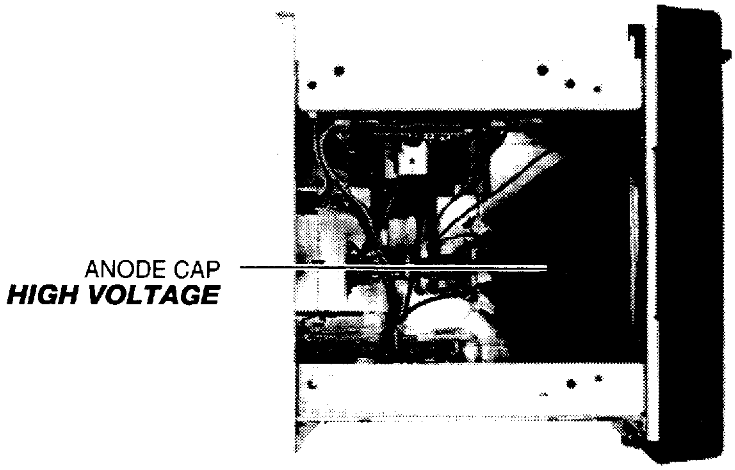


Figure 3-2 Display unit, cover opened, top view

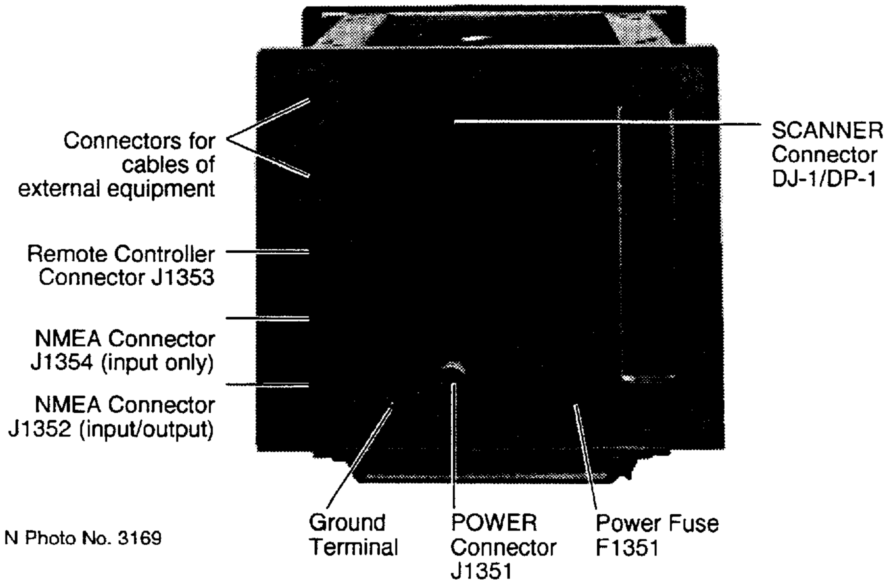


Figure 3-3 Display unit, rear view

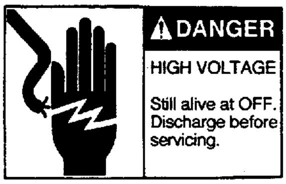
Precautions

This section provides troubleshooting information for the service technician.

Before reviewing this chapter please read the safety information which follows.

To the user

If something appears to be wrong with your unit, check it by referring to the troubleshooting table. If you cannot restore normal operation, please do not attempt to check inside any unit. This equipment uses high voltage electricity which can cause severe injury or death. Any repair work is best left to a qualified technician.



To the service technician

There are many high tension points in this radar system. Take special care when approaching the following parts.

- Power supply circuit (display unit)
- CRT circuit (display unit)
- Modulator circuit and magnetron (transceiver unit)
- Motor drive circuit



Turn off the radar before servicing the antenna.

Troubleshooting Table

This section provides a troubleshooting table for use by both the user and the service technician.

Table 4-1 Troubleshooting table

If...	But...	Then...	Remedy
you pressed the POWER key to turn on the radar	the control panel does not light	• check fuse. • battery may have discharged. • check FIL Board. • check POWER Board. • check illumination lamps.	• Measure input voltage between #1 (+) and #2 (-) terminals of J1301 on the POWER Board. Voltage should be: 12V set: 10.2V to 20.3V DC 24V/32V set: 20.4V to 41.6V DC (See Figure 4-1 for location of POWER Board.)
	nothing appears on the display (panel lights)	• check CRT. • check CRT voltage. • check CRT Board.	• check CRT heater. If lit, CRT is normal. • On the CRT Board, adjust CONTRAST pot. VR101 and BRIGHTNESS pot. VR204.
	picture is not synchronized	• check CRT Board.	• On the CRT Board, adjust V-HOLD pot. VR401 and H-HOLD pot. VR202.
If you pressed the STBY TX key after "ST-BY appears"	but scanner does not rotate	• On the Installation Setup 1 menu, confirm that "Ant on Tx" is set to "ROTATE." • check scanner drive gears. • check scanner motor power circuit. • check scanner motor B801.	

NOTE: *This radar contains a power protection circuit which turns on when voltage is too high. If the power cuts off suddenly it may be because the power protection circuit has actuated. To restore normal operation, press the* **POWER** *and* **STBY TX** *keys together.*

If...	But...	Then...	Remedy
you adjusted sensitivity with both A/C RAIN and A/C SEA off	neither noise nor targets appear (indications and markers do)	• check IF AMP Board. • check multicore cable between scanner and display for damage. • check SPU Board.	
	neither indications nor markers appear (noise and targets do)	• check SPU Board. • check trigger line of signal cable for short. • measure magnetron current (voltage). • check modulator circuit.	Measure magnetron voltage as follows. 1) Transmit on max. range with scanner rotation suspended. (See procedure shown below.) 2) Measure voltage at test point TP803 #5(+) and #6(−) on MD Board in scanner unit. Voltage should 7.5V ±0.1V. Replace magnetron if voltage is not within that range.
	the sweep is not synchronized with scanner rotation	• check bearing pulse generator circuit in scanner. • check SPU Board.	
	sensitivity is poor	• measure magnetron voltage as prescribed above. • MIC may be out of tune.	
you pressed a key	there is no response	• keyboard may be faulty. • check SPU Board.	

Transmitting With Scanner Rotation Suspended

1) Turn off the power.
2) While pressing and holding down the **GAIN** control (hold at least three seconds) press the **POWER** key.
3) Press the **MENU** key.
4) Operate the trackball to select “7. Installation Setup 1,” and then press the **MENU** key.
5) Operate the trackball to select “4. Ant on Tx” and “Stop.”
6) Press the **MENU** key twice to close the menu.

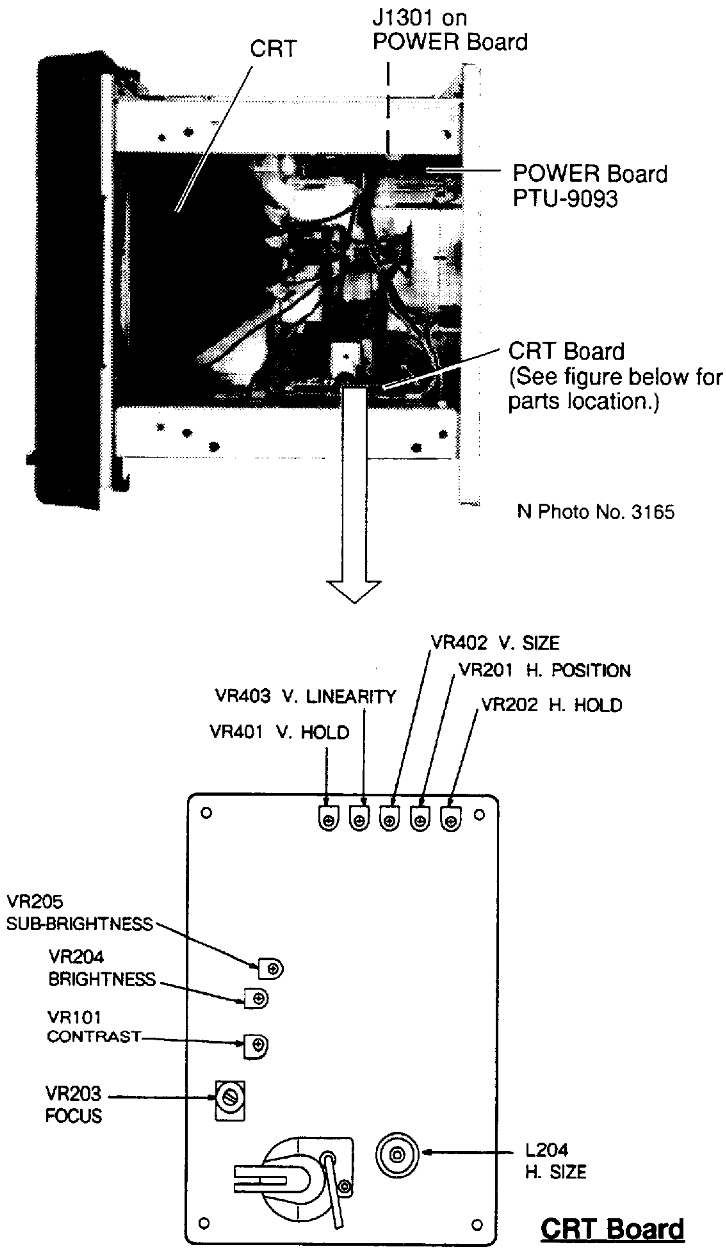


Figure 4-1 Display unit, cover removed, top view, and location of parts on the CRT Board

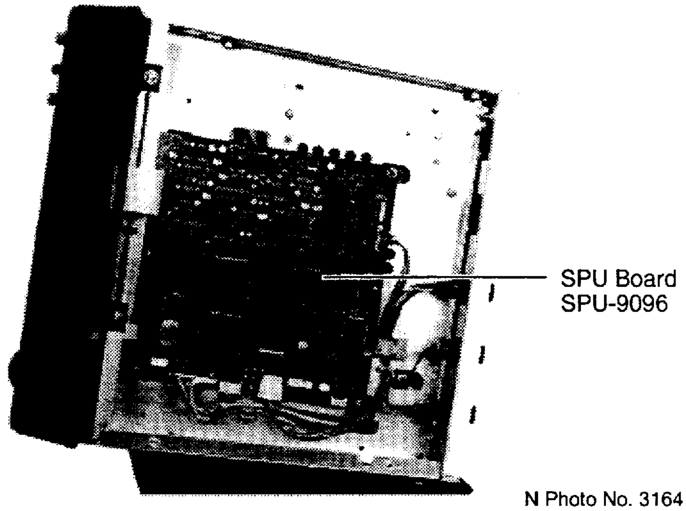


Figure 4-2 Display unit, cover removed, right side view

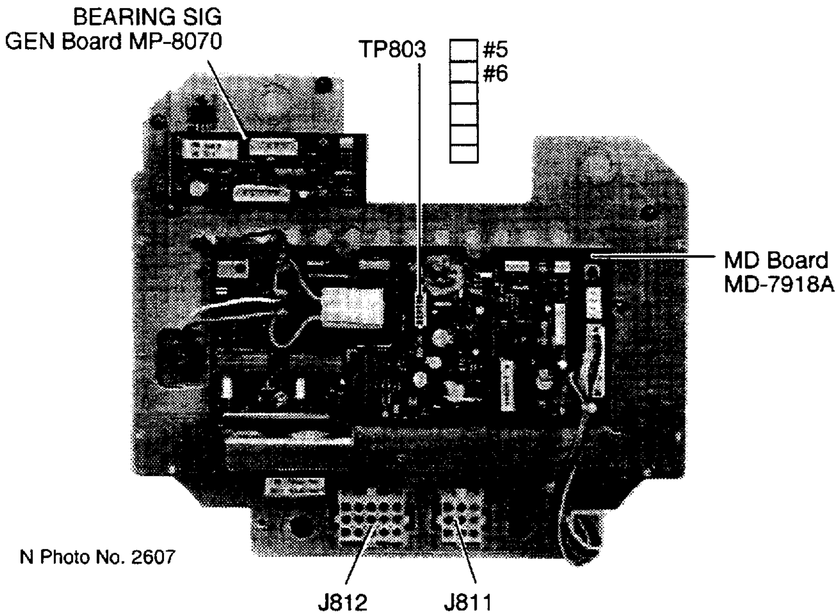


Figure 4-3 Transceiver module bottom view, cover removed

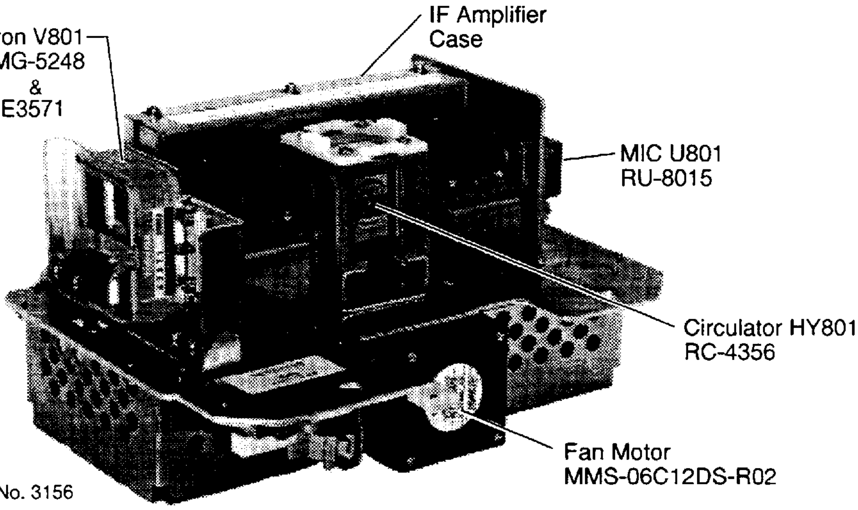


Figure 4-4 Transceiver module

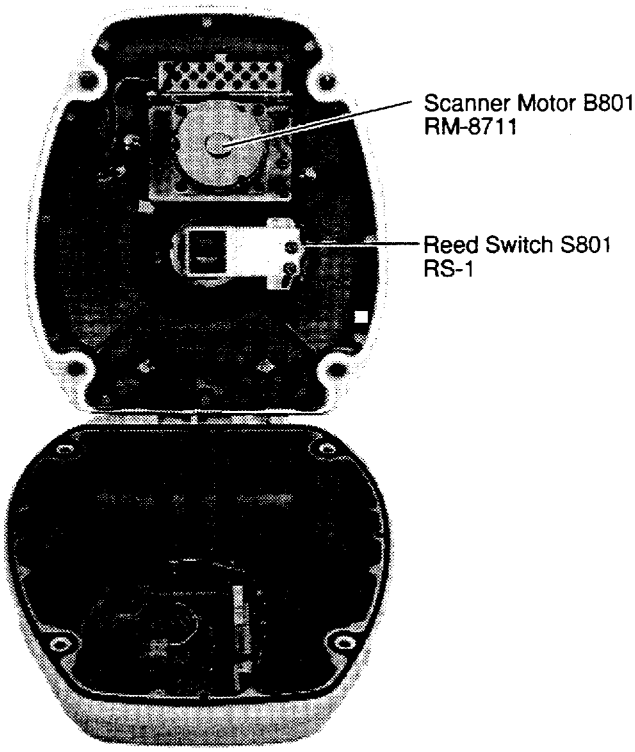
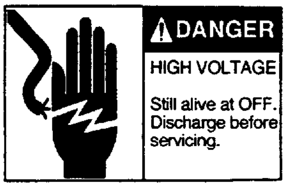


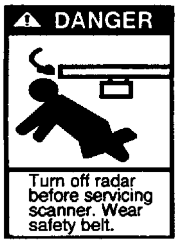
Figure 4-5 Scanner unit, cover opened

Installation Precautions



ELECTRICAL SHOCK HAZARD

A cathode ray tube, in the display unit, uses a high tension of several thousand volts. Unqualified personnel should not open the display unit and the transceiver module (in the scanner unit).



Wear a safety belt

Wear a safety belt when working on the scanner unit.

Scanner Unit Installation

Siting considerations

- The scanner unit is generally installed either on top of the wheelhouse or on the radar mast on an appropriate platform. It should be placed where there is a good all-round view with, as far as possible, no part of the ship's superstructure or rigging intercepting the scanning beam. Any obstruction will cause shadow and blind sectors. A mast for instance, with a diameter considerably less than the width of the scanner, will cause only a small blind sector, but a horizontal spreader or crosstrees in the same horizontal plane as the scanner unit would be a much more serious obstruction; you would need to place the scanner unit well above or below it.
- It is rarely possible to place the scanner unit where a completely clear view in all direction is available. Thus, you should determine the angular width and relative bearing of any shadow sectors for their influence on the radar at the first opportunity after fitting. (The method of determining shadow and blind sectors is shown later in this chapter.)
- The scanner unit should be mounted as high as possible on the boat to ensure best performance at maximum range. In addition, if there is a radio direction finder on the vessel, locate its antenna clear of the scanner unit, to prevent interference to the direction finder. A separation of more than two meters is recommended.
- **Compass safe distance:** 1.0 meter (standard compass) and 0.74 meter (steering compass) should be observed to prevent deviation of the magnetic compass.
- The interconnection cable run between the scanner and the display is 10 meters long. If additional cable is required for a particular installation, an unbroken length must be used (namely, no splices allowed!), and the maximum length is 30 meters.
- Deposits and fumes from a funnel or other exhaust vent can adversely affect the aerial performance and hot gases tends to distort the radiator portion. The scanner unit must not be mounted where it may be subjected to temperatures in excess of 70°C.
- ***The scanner base is made of aluminum, which will corrode if the mounting platform is made of iron. For this reason paint the mounting platform if it is made of iron, to prevent electrolytic corrosion.***

- ***Do not paint the radiator aperture, to ensure proper emission of the radar waves.***
- ***To prevent damage to the scanner unit do not lift it by the radiator.***

Mounting

1) Drill four bolt holes (ø13 mm) for scanner housing and one multicore cable entry hole (approx. 50 mm diameter) in the radar mast platform or the deck. See the scanner outline drawing on page D-2.
2) Detach the scanner housing cover from the scanner housing by loosening four fixing bolts. The scanner housing cover fitted with the transceiver module can be stored in a convenient place until the wiring to the scanner unit is accomplished.
3) Place the scanner housing on the chosen position and orient it as shown in Figure 5-1(A).

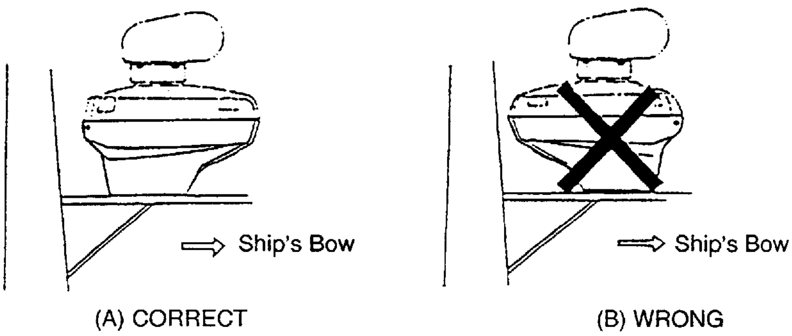


Figure 5-1 Orienting the scanner unit

4) Fasten scanner housing to mounting location;
   a) Coat washer and nuts with silicone sealant.
   b) Set seal washers to M12 x 60 hex bolts with the larger diameter of the washers under the bolt heads.
   c) Insert bolts and seal washers from inside the scanner housing (so they will not touch the transceiver module).
   d) Fasten the scanner housing to the mounting location with flat washers, spring washers and hex nuts as shown in Figure 5-2. ***Fasten by turning the nut (not the bolt) to prevent damage to seal washer.***
   e) Coat exposed parts of nuts and washers as shown in Figure 5-2.

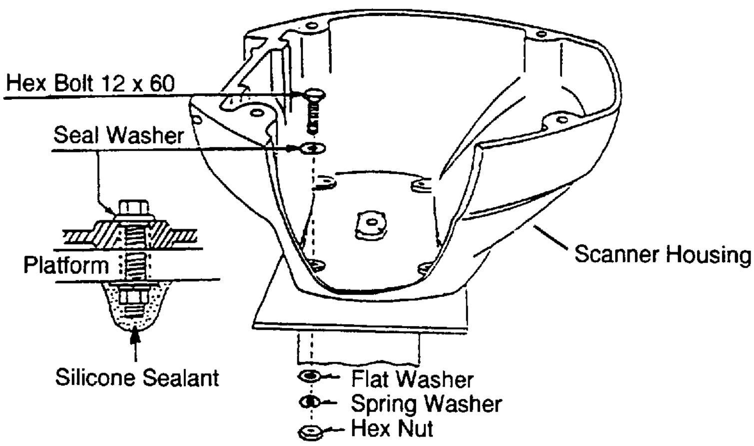


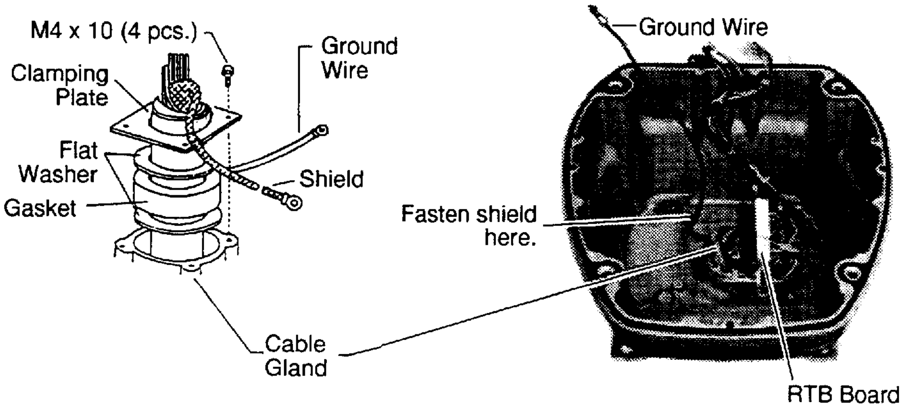
Figure 5-2 Mounting the scanner housing

Connections

Only the multicore cable runs from the display unit to the scanner unit. Make the hole for passing the cable through the bulkhead or deck at least 20 mm diameter. In order to minimize the chance of picking up electrical interference, avoid where possible routing the multicore cable near other onboard electrical equipment. Also, avoid running the cable in parallel with power cables. Pass the cable through the hole and apply sealing compound around the hole for waterproofing.

The procedure for connecting the multicore cable to the scanner unit is as follows;

1) Through a pipe or waterproof cable gland fitted on the wheelhouse top or bulkhead.
2) Remove the cable gland on the bottom of the scanner housing.



NOTE: *Use the gasket attached inside the scanner unit for the previous cable RW-6537.*

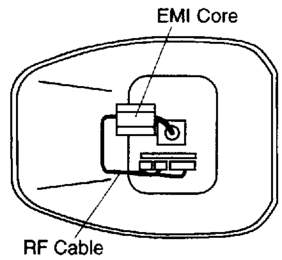
Figure 5-3 Passing the multicore cable through the scanner housing

3) Pass the multicore cable through the scanner base and the cable gland (removed in step 2.)

4) Secure the cable gland to the scanner base for complete watertightness.

5) Connect the lead wires to the RTB Board on the bottom of the scanner housing by referring to the interconnection diagram on page S-1.

6) Attach the EMI core supplied as show below. The core must be as closer to the cable gland as possible.



How to use EMI core

7) Connect the inner shield of the multicore cable to the ground terminal at the bottom of the scanner housing.

Final preparation

1) Place the scanner housing cover onto the scanner housing. Coat rubber gasket with grease. Making sure the gasket rests properly in the groove, fasten the four fixing bolts temporarily by hand.

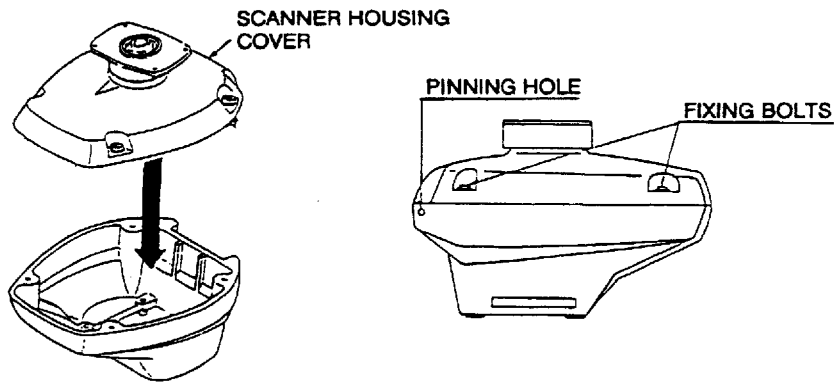


Figure 5-4 Fixing the scanner housing cover

2) Coat the two slot pins with grease. Using a wooden mallet (to prevent chipping of paint), insert the pins into the pinning holes (see Figure 5-4) until the pin head is flush with the scanner housing surface.

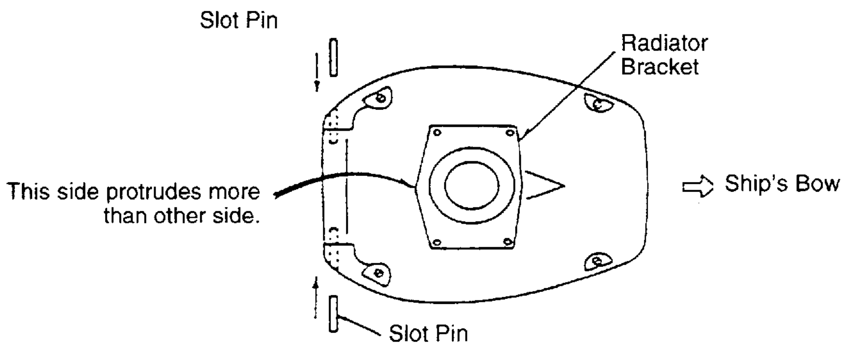


Figure 5-5 Inserting of slot pins

3) Now is the time to fix the radiator to the radiator bracket. Remove the red rubber cap on the radiator bracket and orient the radiator bracket as shown in Figure 5-5. Referring to Figure 5-6, apply anticorrosive silicone sealant to the radiator bracket as shown below and apply grease to the O-ring and set it to the center of the radiator bracket. Coat the radiator fixing bolts with silicone sealant. Fix the radiator to the radiator bracket with the FURUNO logo on the radiator facing ship's bow.

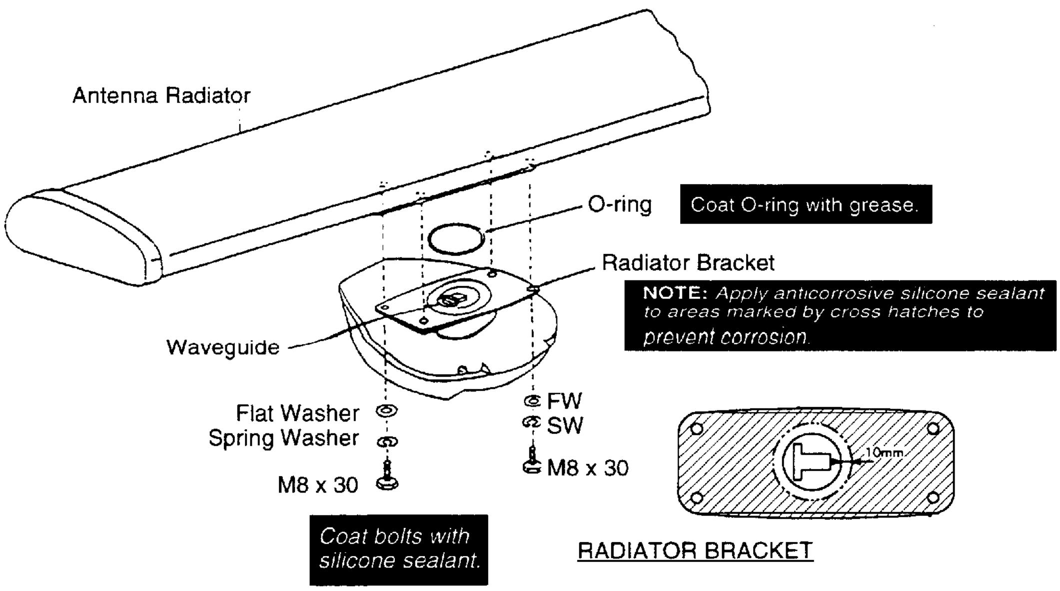


Figure 5-6 Fixing the radiator to the scanner housing

4) Open the scanner housing cover and fix the stay as shown in Figure 5-7.

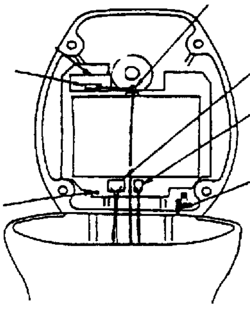


Figure 5-7 Scanner unit, cover opened

5) One end of the cable with 15-, 9- and 7-way plugs has already been connected to the RTB Board inside the scanner housing. Mate the 15- and 9-way plugs with jacks J812 and J811 on the transceiver module, respectively. Connect the 7-way plug to jack J701 on the MP Board. Secure the cable between the RTB Board and J701 with the cable tie as shown in Figure 5-7.

6) The black wire of the cable is the ground wire. Fasten it to the chassis of the transceiver module with the ground screw shown in Figure 5-7.

7) Close the scanner housing cover.

Display Unit Installation

Siting considerations

- The display unit can be mounted on a tabletop, a bulkhead or on the overhead. Install it where it can be viewed and operated conveniently, but where it is protected from being sprayed or immersed in salt or fresh water.
- **Compass safe distance:** The magnetic compass may be affected if the display unit is placed too close to it, because of the magnetic fields generated in the radar. The compass safe distance is approximately 1.0 meters for the standard compass and approximately 0.8 meters for the steering compass.
- The display unit should be oriented so that you can view the screen while facing towards the bow. This will make determination of your position easier.
- The mounting location must be strong enough to support the display unit under vibration conditions normally encountered on the vessel. If necessary reinforce the mounting location.
- Make sure you allow enough clearance to get to the connectors behind the unit. Make sure you leave at least a foot or so of "service loop" of cables behind the unit so that it can be pulled forward for servicing or easy removal of the connectors.

Tabletop mounting

1) Loosen the two M8 x 40 bolts at the front of the display unit. Remove the fixing plate.
2) Using the fixing plate as a template, mark screw locations in the tabletop. Drill four holes of 12 mm diameter in the tabletop.
3) Secure the fixing plate to the tabletop with M10 bolts, nuts and washers.
4) Lay the display unit on the fixing plate. Secure it with the two M8 x 40 bolts loosened in step 1. Cover the bolts with the two cosmetic caps (supplied).

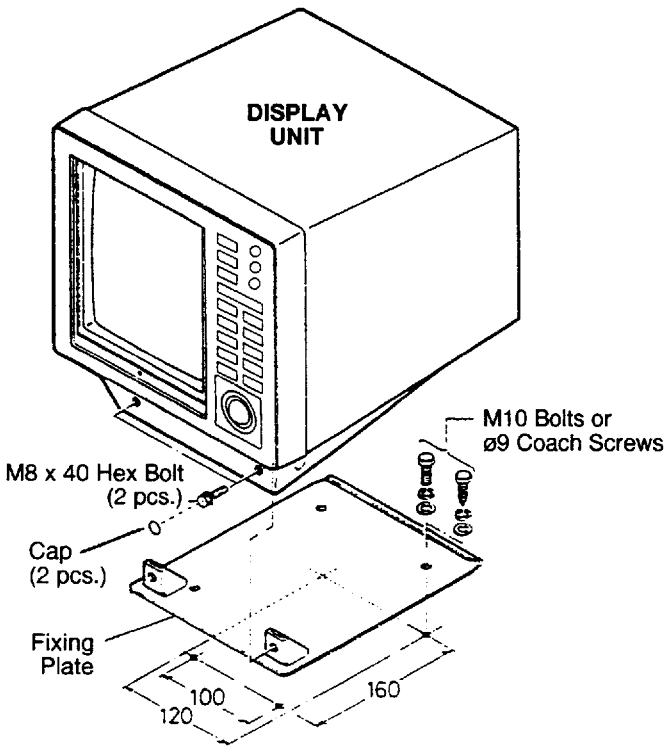


Figure 5-8 Tabletop mounting

Bulkhead or overhead mounting

1) Referring to Figure 5-9, change the location of the fixing plate, mounting base, bottom plate and cover.

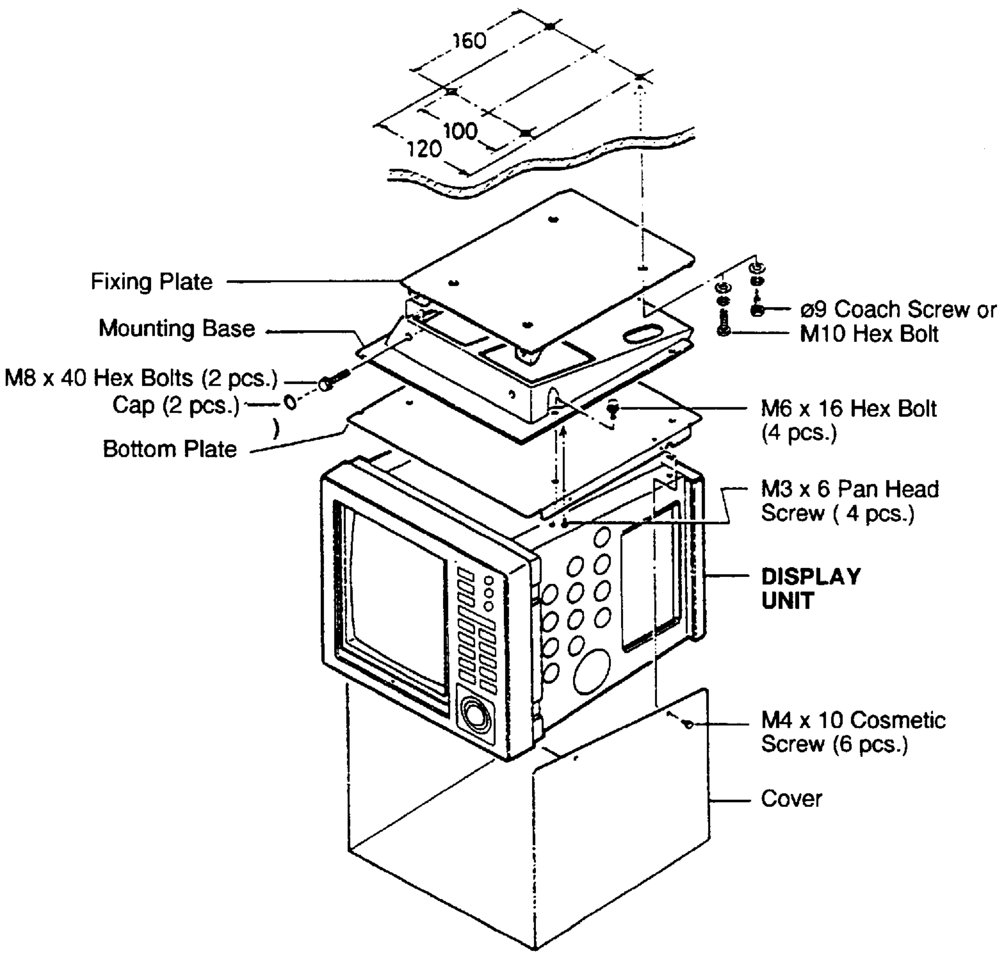


Figure 5-9 Display unit bulkhead or overhead mounting

Connections

The figure on the next page shows location of connectors on the rear of the display unit. Several types of cables (with connectors) for connection of external equipment are optionally available. See the optional equipment list on page viii for details.

Scanner connection

Connect the multicore cable from the scanner unit to connector DJ-1 on the rear of the display unit.

Power connection

This radar is designed for 12, 24 or 32 volt battery systems. No modification is required except change of fuse. A piece of gear of this quality deserves to have a circuit breaker dedicated to it alone. The size of the wire feeding power to the unit should be no less than AWG #14 (2.0 mm^2).

A power cable comes with the radar; connect it to the power connector on the rear of the display unit.

Ground connection

Run heavy ground wire from the grounding terminal at the rear of the panel of the display unit to the nearest grounding point on the boat. Consult with a qualified electrician if you are uncertain of where the grounding points on your vessel are.

Remote controller connection

Connect the remote controller to J1353 (REMOTE).

External navaid connection

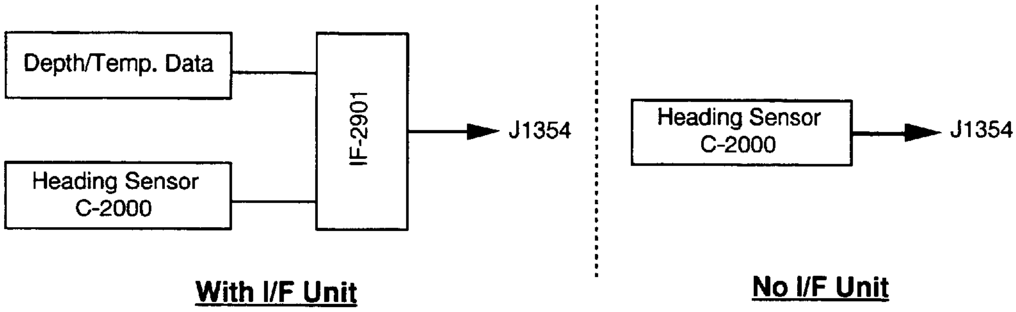
By connecting an external navaid which has NMEA 0183 signal format, own ship's speed, position in latitude/longitude, and the range and bearing to waypoint can be input to this radar, and be seen in the bottom text area. Further, waypoint position is marked on the scree and cursor position can be output to the navaid.

An NMEA cable fabricated with a connector is optionally supplied. Remove the NMEA IN/OUT jack cap on the rear panel to expose the NMEA jack.

RSD signal is output from the NMEA IN/OUT jack at the interval of several seconds.

Heading sensor connection

When a heading sensor outputs NMEA 0183 heading data to this radar, digital heading indication, the north mark and true EBL indication can be displayed. The connection method is shown below. Note that a gyrocompass cannot be connected.



Monitor connection

A full function monitor (FMD-8000) and/or a remote radar display (FMD-1800) can be connected (to the SPU Board). For wiring information, see the interconnection diagram.

Echosounder, temperature indicator connection

Water depth and temperature can be displayed on the radar screen. Connect echosounder or temperature indicator to the NMEA IN jack on the rear of the display unit.

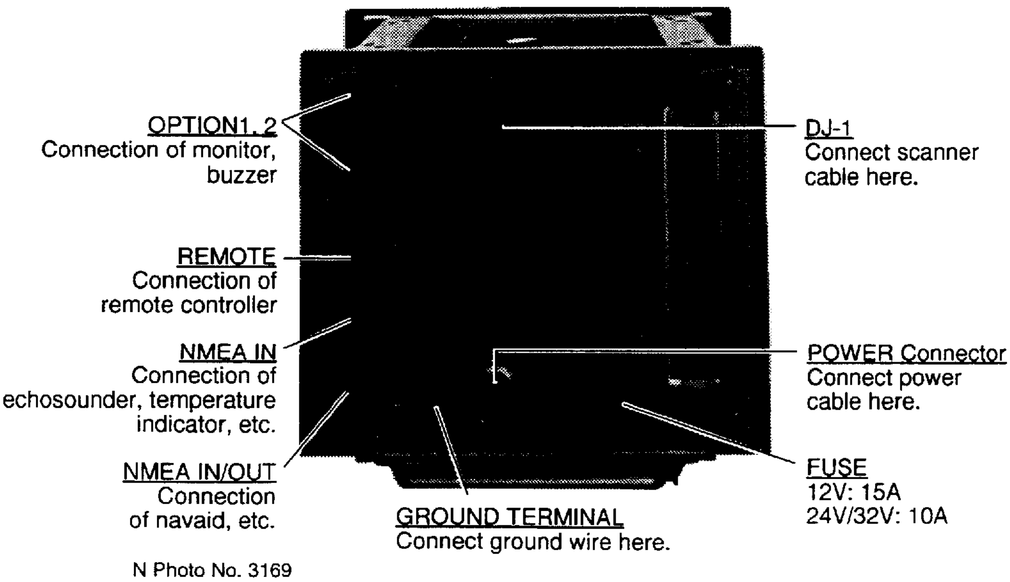


Figure 5-10 Display unit, rear view

Nav Data Input/Output

Input (NMEA 0183 format) ★★: GP, LC, or any talker

$★★APB, $★★BWC, $★★DPT, $★★GLL, $★★GLC, $★★HDG, $★★MDA, $★★RMA, $★★RMB, $★★RMC, $★★VTG, $★★XTE, $★★DBK, $★★DBS, $★★DBT, $★★GTD, $★★HDM, $★★HDT, $★★MTW, $★★BWR, $★★VHW
AD-10 format: Heading data

Output (NMEA 0183 format)

$RATLL, $RARSD

Checking the Installation

After completing the installation, it is a good idea to recheck it to be sure all steps were correctly done. Use the installation check list below to check the installation. Tick box to indicate completion.

- ❒ The multicore cable is waterproofed at the scanner base.
- ❒ The multicore cable is securely retained against the mast or mounting platform and is free of interference from running rigging.
- ❒ The cable gland or entry on the deck, if provided, is waterproofed.
- ❒ The power connections to the battery are of correct polarity.
- ❒ The plugs at the rear of the display unit are tightly fastened.
- ❒ The fuse on the rear panel of the display unit is 15A (12V power) or 10A (24V/32V power).

Adjustments on the Installation Setup 1 Menu

Overview

This section covers adjustment of the radar after installation, on the Installation Setup 1 menu.

Preparation

These adjustments are done through the installation setup menus.

1) Turn off the radar. While pressing and holding down the **GAIN** control about three seconds, press the **POWER** key. This sequence opens the installation menus.)

2) When "ST-BY" appears, press the **STBY TX** key to transmit.

3) Select maximum range and adjust the **GAIN** control so the background noise is just visible on the display.

4) Press the [–] key several times to select the minimum range. Adjust the **A/C SEA** control to display nearby radar targets clearly on the screen.

Selecting options on installation setup 1 menu

1) Press the **MENU** key to display the menu.

[MAIN MENU]
Select item by trackball and press ENTER key.

1. Backlight/Brilliance	
2. P/L & Int/Noise Rej	
3. Nav Data	
4. Mode & Function	
5. Tuning	AUTO MANUAL
6. Self Check	
7. Installation Setup 1	

Press GAIN to temporarily hide menu.

<Press MENU key to escape.>

Figure 5-11 Menu

2) Operate the trackball to select "7. Installation Setup 1," and then press the **ENTER** key.

[INSTALLATION SETUP 1]
Select item and option by trackball.

1. Key Beep	OFF ON
2. Alm Sensor Lvl	LOW MED HIGH
3. Hdg Sensor	MAG GYRO
4. Ant on Tx	ROTATE STOP
5. Ant Height	LOW MED HIGH
6. Operation Mode	MASTER SLAVE
7. Installation Setup 2	

Press GAIN to temporarily hide menu.

<Press MENU for main menu.>

Figure 5-12 Installation setup 1 menu

3) Roll the trackball vertically to select item and horizontally to select option. Press the **ENTER** key. Repeat sequence for each item. Refer to the table on the next page for guidance.

Table 5-1Installation setup 1 menu description

Item	Description
1. Key Beep	Turn key beep response on/off.
2. Alm Sensor Lvl	Select level of echo intensity which triggers guard alarm; low, medium, or high.
3. Hdg Sensor	Select source of heading data; magnetic compass (MAG) or gyrocompass (GYRO).
4. Ant on Tx	Select STOP to halt antenna rotation on transmission.
6. Operation Mode	Select radar operation mode; master or slave.
7. Installation Setup 2	Select to access Installation Setup 2 menu.

This concludes operation on the Installation Setup 1 menu. Leave the menu open to align heading, adjust sweep timing, etc. on the Installation Setup 2 menu.

Aligning Heading

You have mounted the scanner unit facing straight ahead in the direction of the bow. Therefore, a small but conspicuous target dead ahead visually should appear on the heading mark (zero degrees).

In practice, you will probably observe some small error on the display because of the difficulty in achieving accurate initial positioning of the scanner unit. The following adjustment will compensate for this error.

1) Identify a suitable target (for example, ship or buoy) at a range between 0.125 to 0.25 nautical miles, preferably near the heading mark. To lessen error, keep echoes in the outer half of the picture by changing the range. Also, be sure the zoom and off center functions are off.

2) Operate the trackball to select "7. Installation Setup 2" on the menu display, and then press the **ENTER** key.

```
[ INSTALLATION SETUP 2 ]
Select item and option by trackball.

1. Align Heading
2. Adjust Sweep Timing
3. On Hours                    000001.5H
4. Tx Hours                    000000.3H
5. Dead Sector                 000°-000°
-----------------------------------------
Press GAIN to temporarily hide menu.

<Press MENU for inst setup 1.>
```

Figure 5-13 Installation setup 2 menu

3) Operate the trackball to select "1. Align Heading," and then press the **ENTER** key. EBL1 appears on the display.

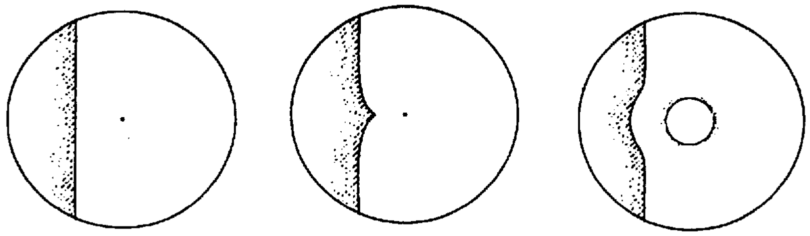
4) Operate the trackball to bisect the target selected at step 1 with EBL1, and then press the **ENTER** key.

5) As a final test, move the boat towards a small buoy and confirm that the buoy shows up dead ahead on the radar when it is visually dead ahead.

Adjusting Sweep Timing

The radar measures the time required for a transmitted echo to travel to the target and return to the source. The received echo appears on the display based on this time. Thus, at the instant the transmitter is fired, the sweep should start from the center of the display (sometimes called sweep origin.)

A trigger pulse generated in the display unit goes to the scanner unit through the signal cable to trigger the transmitter (magnetron). The time taken by the signal to travel up to the scanner unit varies, depending largely on the length of signal cable. During this period the display unit should wait before starting the sweep. When the display unit is not adjusted correctly, the echoes from a straight local object (for example, a harbor wall or straight pier) will not appear with straight edges—namely, they will be seen as "pushed out" or "pulled in" near the picture center. (See Figure 5-14.) The range of objects will also be incorrectly shown.



(1) Correct (2) Target pulled inward (3) Target pushed outward

Figure 5-14 Examples of improper and correct sweep timings

1) Transmit on the shortest range and confirm that the **GAIN** and **A/C SEA** controls are properly adjusted.
2) Visually select a target which forms right angles (harbor wall, straight pier).
3) Press the **MENU** key, if the menu is not displayed.
4) Operate the trackball to select "2. Adjust Sweep Timing," and then press the **ENTER** key.
5) Operate the trackball to straighten target selected at step 2, and then press the **ENTER** key.

If measurement of blind sector or entry of area of not transmission is not necessary, this concludes adjustment. Turn off the power to finish.

Measuring Blind and Shadow Sectors

In some shadow sectors, there may not be sufficient intensity to obtain an echo from very small targets even at close range, although a large vessel may be detected at a much greater range in non-shadowed sectors. For these reasons the angular width and relative bearing of any shadow sectors should be determined. For a new vessel this should be done during sea trials. In other ships it should be done at the first opportunity after installing the radar.

Even a small shadow sector may hide another vessel if she is on a collision course with your vessel. The bearing will remain constant in the shadow area and the approach of the other vessel may remain undetected until it is too late to avoid a dangerous situation.

Two methods of determining the angular width of a shadow sector are:

- Turn the boat very slowly through 360° while a small but clearly defined target is observed at a distance of a mile or so.

(Do not use a buoy with a reflector as this target is too powerful to achieve the required result.) If the echo disappears while the boat is turning, the target has entered a shadow sector and it will again become visible when the target emerges from the shadow. Very quiet conditions of wind and sea are essential to ensure reliable results when this operation is carried out on a small craft since a rough sea can cause a buoy to be lost in the clutter or be temporarily submerged or hidden by waves. An unsteady movement may cause the boat to swing through a shadow sector before the scanner has completed one revolution. In any case an average of several observations of each shadow sector should be taken. It is a waste of time to attempt the operation in anything other than very smooth water with little wind.

- Another method is to observe the shadow sector against a background of sea clutter. Any shadows will show as dark sectors in the clutter. See Figure 5-15.

Note that a shadow cannot be fairly estimated in heavy clutter, as echoes from either side of the sector may be spread into it and give an illusion that objects in the sector are being observed. Nor can it be satisfactorily determined in confined waters, because of the probability of indirect, false or multiple echoes being produced from nearby building or other vessels.



Figure 5-15 Appearance of a shadow sector on the display

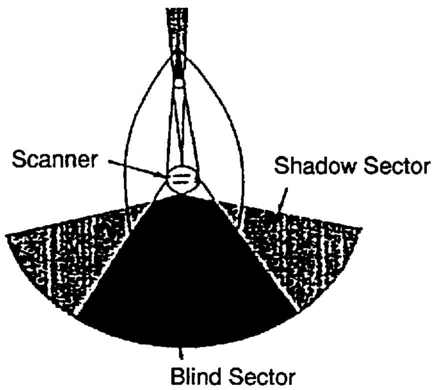


Figure 5-16 Sample blind and shadow sectors

Preventing Transmission in an Area

When the antenna is installed at a close distance in front of the wheel house and this presents a rf radiation hazard, the radar should be set to not transmit within this area. (Some authorities require this.) This feature can also be used to prevent transmission in a blind or shadow sector. The maximum sector is 270°.

Entering area of no transmission

1) Display the Installation Setup 2 menu.
2) Operate the trackball to select "5. Dead Sector" and press the **ENTER** key.
3) While monitoring the display, operate the trackball to enter start of dead sector. Press the **ENTER** key.
4) Operate the trackball to enter end of dead sector. Press the **ENTER** key.
5) This concludes all adjustments on the installation menus. Turn off the power to finish.

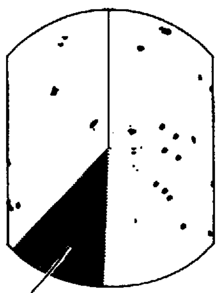


Figure 5-17Appearance of area of no transmission on the display

Cancelling area of no transmission

Follow "Entering area of no transmission" on previous page and enter all zeroes.

Adjusting Magnetron Heater Voltage

Magnetron heater voltage is formed at the MD Board of the scanner unit and preadjusted at the factory for use with any length of signal cable. Therefore no adjustment is required. However, verify heater voltage by following the procedure below.

1) Turn on the radar and set it in stand-by.
2) Open the scanner housing cover. Connect a multitester, set to 10V DC range, between #5(+) and #6(–) of test point TP803 on the MD Board in the scanner unit.
3) Confirm that the multitester shows 7.5V ±0.1V. If it does not, adjust potentiometer VR801 on the MD Board.
4) Close the scanner housing cover and tighten the fixing bolts.

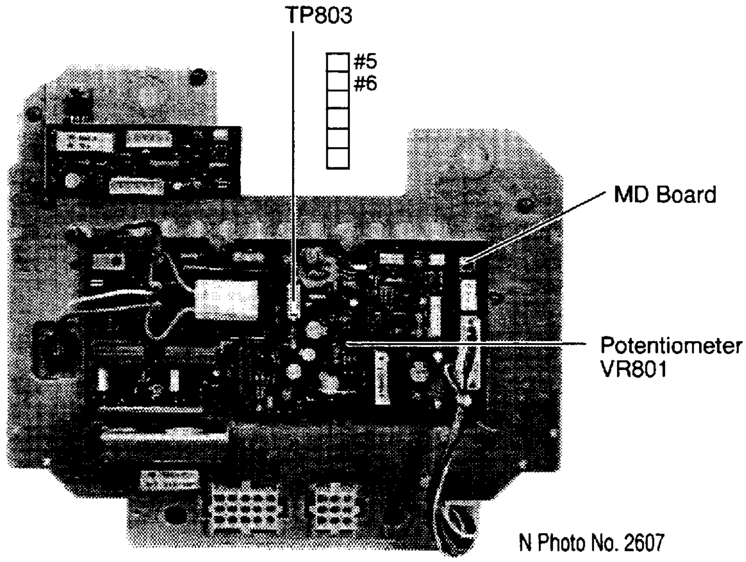


Figure 5-18 Transceiver module, bottom view, cover removed

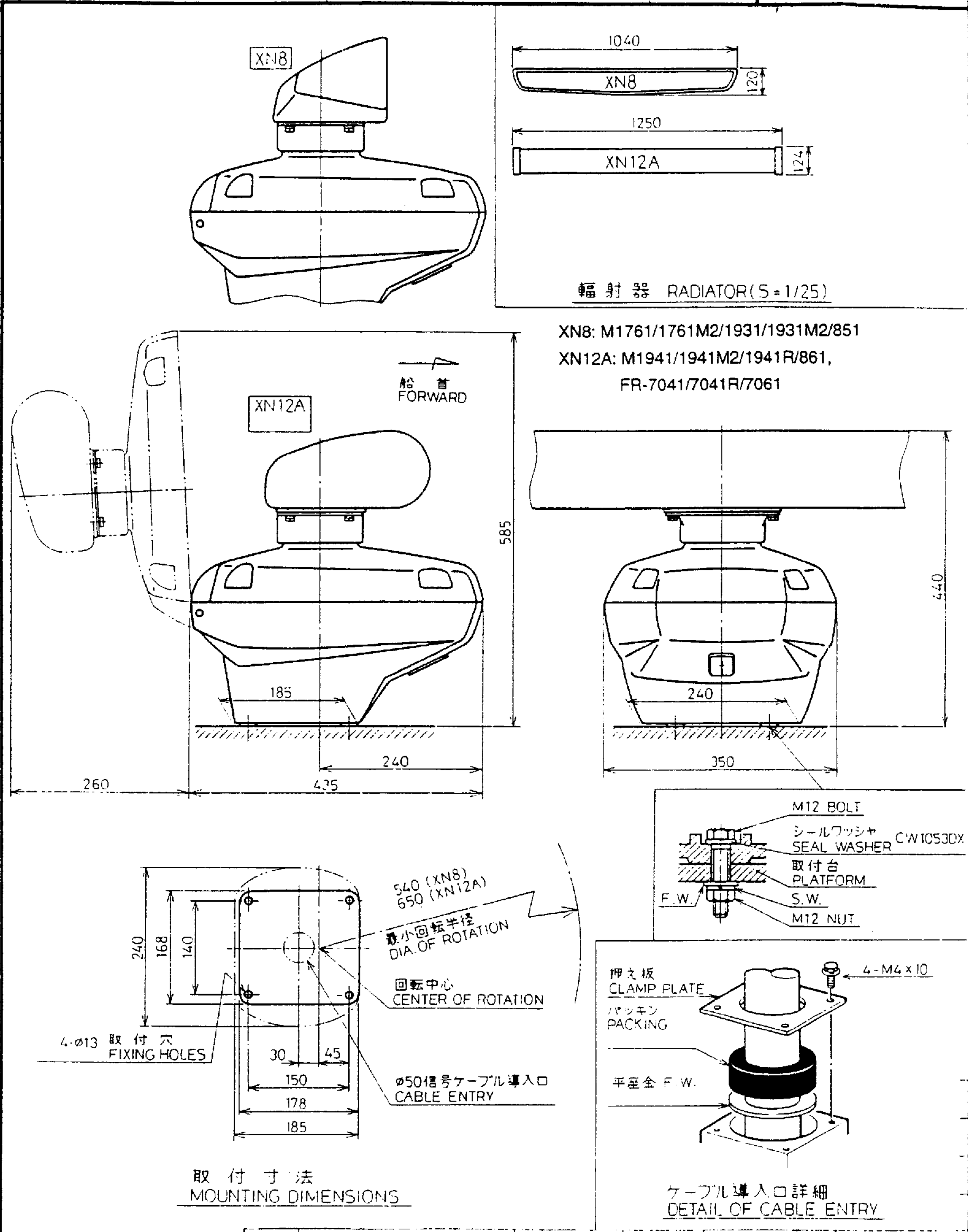
List of Outline Drawings & Schematic Diagrams

Table D-1 Outline drawings

Drawing	Type	Drawing No.	Page
Display Unit	RDP-108/109/110	C3392-G01	D-1
Radar Scanner Unit	XN12A-RSB-0065	C3380-G01	D-2

Table D-2 Schematic diagrams

Drawing	Type	Drawing No.	Page
Interconnection Diagram	FR-7041R	C3394-C01	S-1
Display Unit	RDP-110	C3394-K01	S-2
Radar Scanner Unit	RSB-0065	C3384-K01	S-3



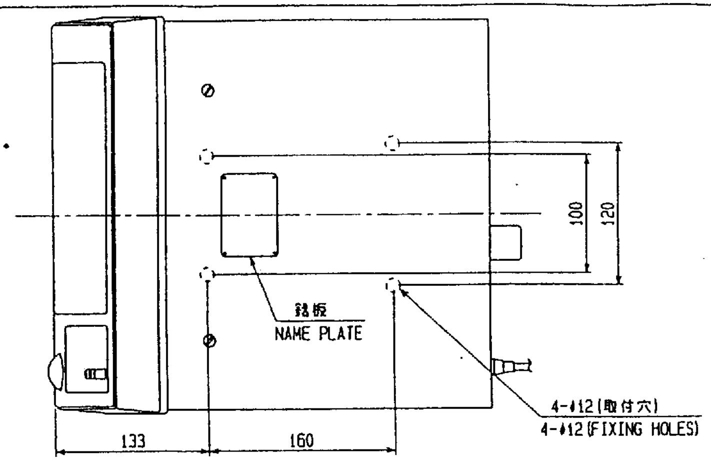
品番 ITEM	品 名 NAME	材 質 MATERIAL	数 量 Q'TY	図 番 DWG. NO.	摘 要 REMARKS

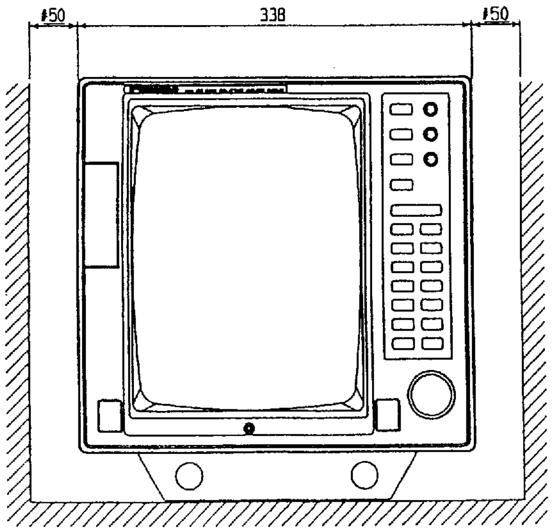
承 認 APPROVED	OCT·22·'92 M. IKEDA	三 角 法 THIRD ANGLE PROJECTION		名 称 TITLE	XN8-RSB-0061, XN12A-RSB-0062/65 レーダー空中線部 RADAR SCANNER UNIT
検 図 CHECKED	Oct·22·'92 T. TAKAHASHI	尺 度 SCALE			
製 図 DRAWN	Oct·22·'92 [illegible]	重 量 WEIGHT	23(XN8) 20(XN12A) kg	図 番 DWG. NO.	C3380-G01-E

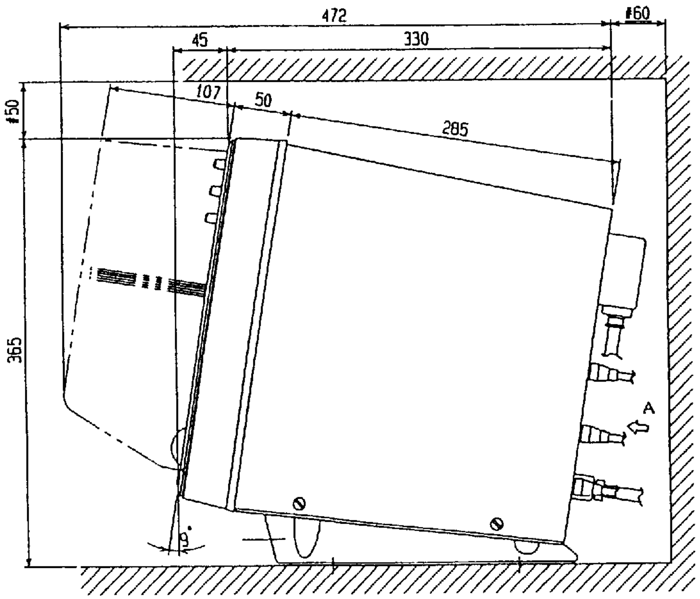
FURUNO ELECTRIC CO., LTD.

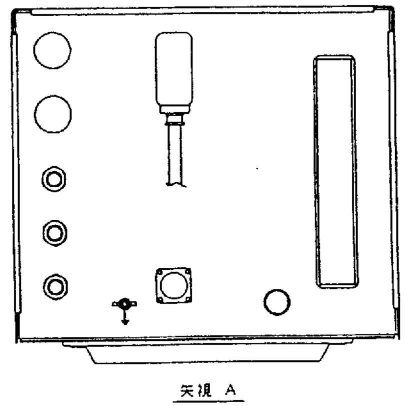
注　記　1）装備ケーブルはサービス時、指示部を前方に充分引き出せるよう
余裕を持たせること。
2）装備ケーブルの端末処理は　装備要領書参照のこと。
3）取付用ネジはM10ボルトまたはコーチボルト呼び径9を使用のこと。
4）#印寸法は最小サービス空間寸法とする。

NOTE
1) SUFFICIENT EXTRA CABLINGS SHOULD BE ALLOWED AT THE BACK OF THE UNIT SO THAT THE UNIT CAN BE DRAWN OUT WITH THE CABLES CONNECTED FOR MAINTENANCE.
2) REFER TO INSTALLATION INSTRUCTION FOR FABRICATION OF CABLE ENDS.
3) USE M10 BOLTS OR #9 COACH SCREWS FOR FIXING THE UNIT.
4) # : RECOMMENDED SERVICING CLEARANCE.



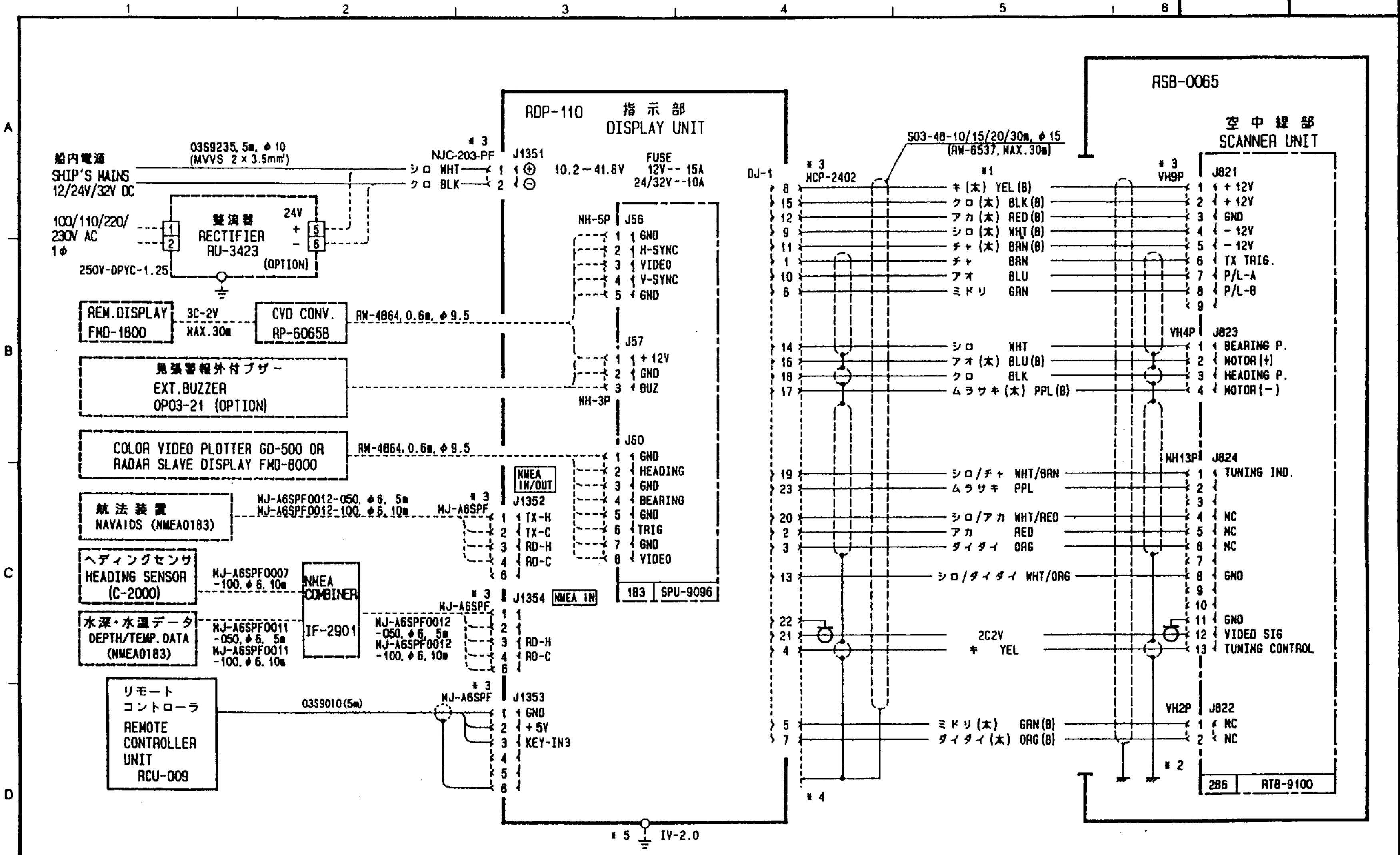






DRAWN Sept. 11 '96 K. Kusunoki	FR-7111 FR-7061 FR-7041R FR-7041		TYPE RDP-108/109/110
CHECKED Sept 11 '96 K. OTA			名称 レーダー指示部 外寸図
APPROVED Sept 11 '96 K. OTA			
SCALE 1/4 · MASS 12.5 kg	APPLICABLE TO: (MODEL)	BLOCK NO.	NAME RADAR DISPLAY UNIT
DWG NO. C3392-G01- C			OUTLINE DRAWING

FURUNO

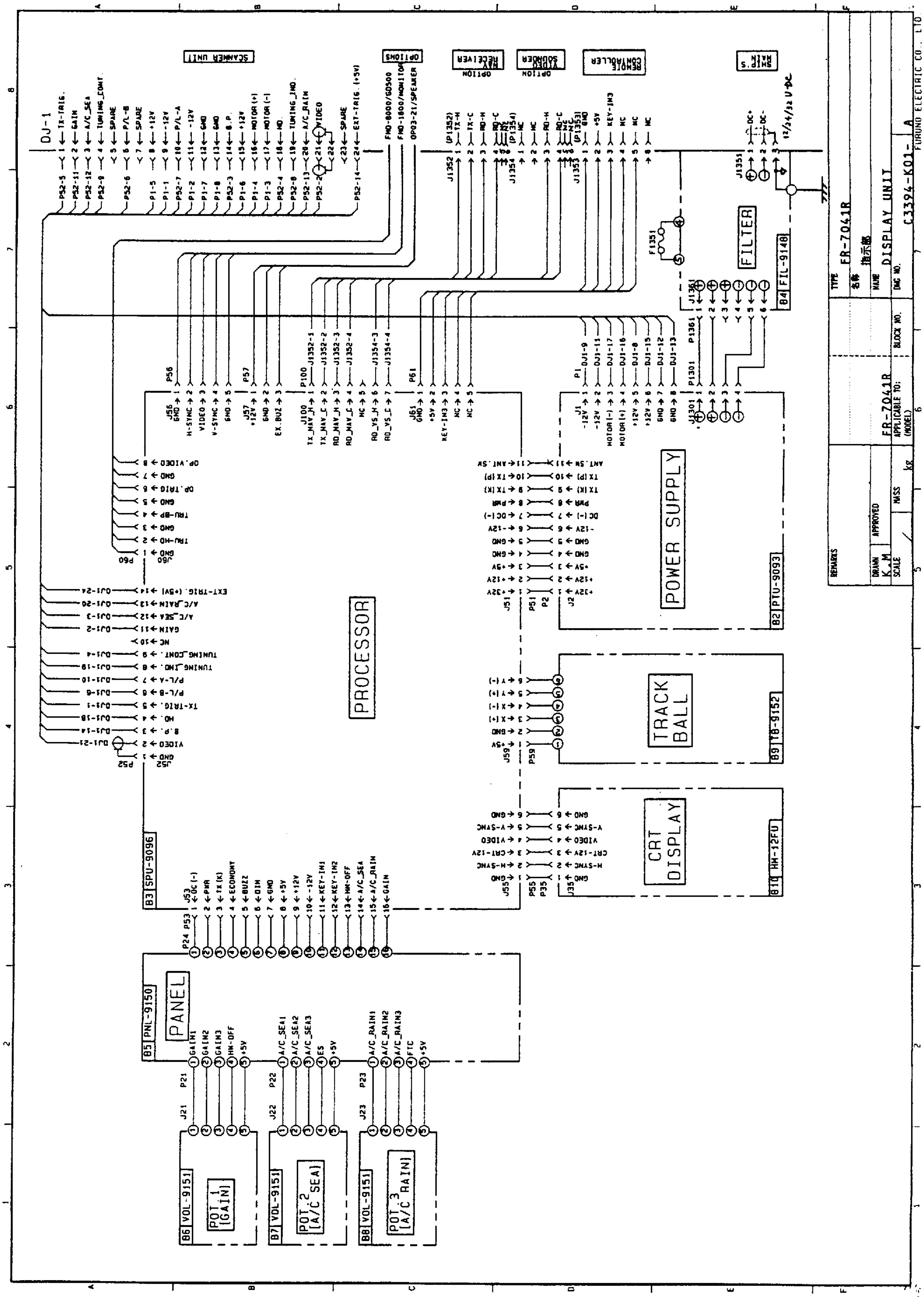


＊1.(太)：太線
＊2.空中線部側のシールドは完全にアースすること。
＊3.コネクタープラグ取付済。
＊4.シールドはコネクターケースを通してアースされている。
＊5.造船所支給。

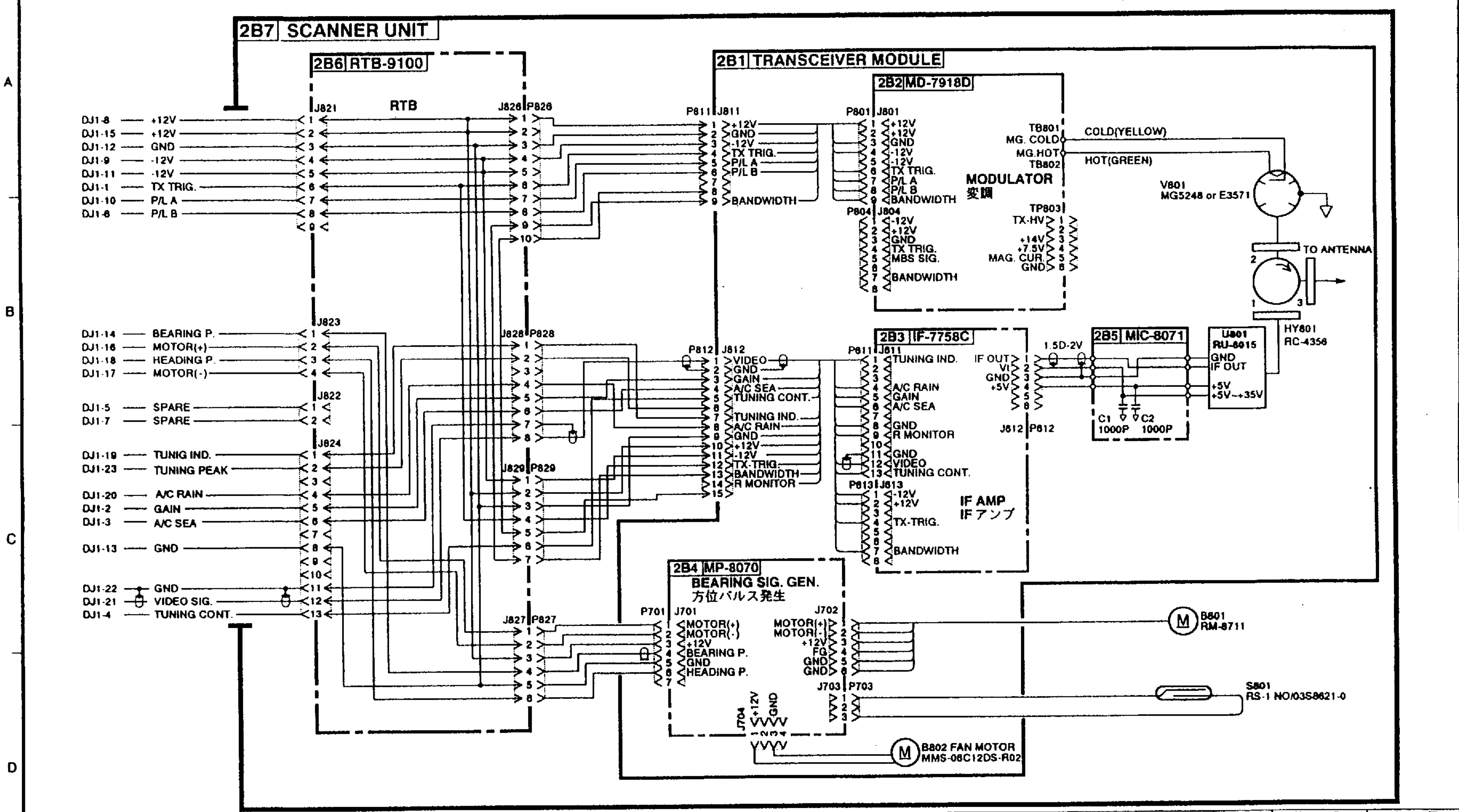
＊1. (B) : LARGE WIRES.
＊2. SHIELD SHOULD BE EFFCTIVELY GROUNDED AT SCANNER UNIT.
＊3. CONNECTOR PLUG FACTORY-WIRED.
＊4. SHIELD GROUNDED THRU CONNECTOR CASE.
＊5. SHIPYARD SUPPLY.

TYPE	FR-7041R
名称	相互結線図
NAME	INTERCONNECTION DIAGRAM
DWG NO.	C3394-C01- B
DRAWN	K.M
APPROVED	[illegible]
APPLICABLE TO: (MODEL)	FR-7041R
SCALE	/
MASS	kg

FURUNO ELECTRIC CO., LTD.


SCANNER UNIT
OPTIONS
NAV RECEIVER
VIDEO SOUNDER
REMOTE CONTROLLER
SHIP'S MAIN
FILTER
PROCESSOR
POWER SUPPLY
TRACK BALL
CRT DISPLAY
PANEL
POT.1 (GAIN)
POT.2 (A/C SEA)
POT.3 (A/C RAIN)
FR-7041R
DISPLAY UNIT
C3394-K01- A
FURUNO ELECTRIC CO., LTD.

FURUNO



品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG. NO.	摘要 REMARKS

承認 APPROVED	FEB・22・'94 IKEDA	三角法 THIRD ANGLE	名称 TITLE	RSB-0065	空中線部 SCANNER UNIT
検図 CHECKED	FEB・22・'94 K.OKAMOTO	尺度 SCALE	/		
製図 DRAWN	FEB・22・'94 MORIMOTO	重量 WEIGHT	kg	図番 DWG.NO	C3384-K01-C

FR-7041R
MODEL 1941R

FURUNO ELECTRIC CO., LTD.